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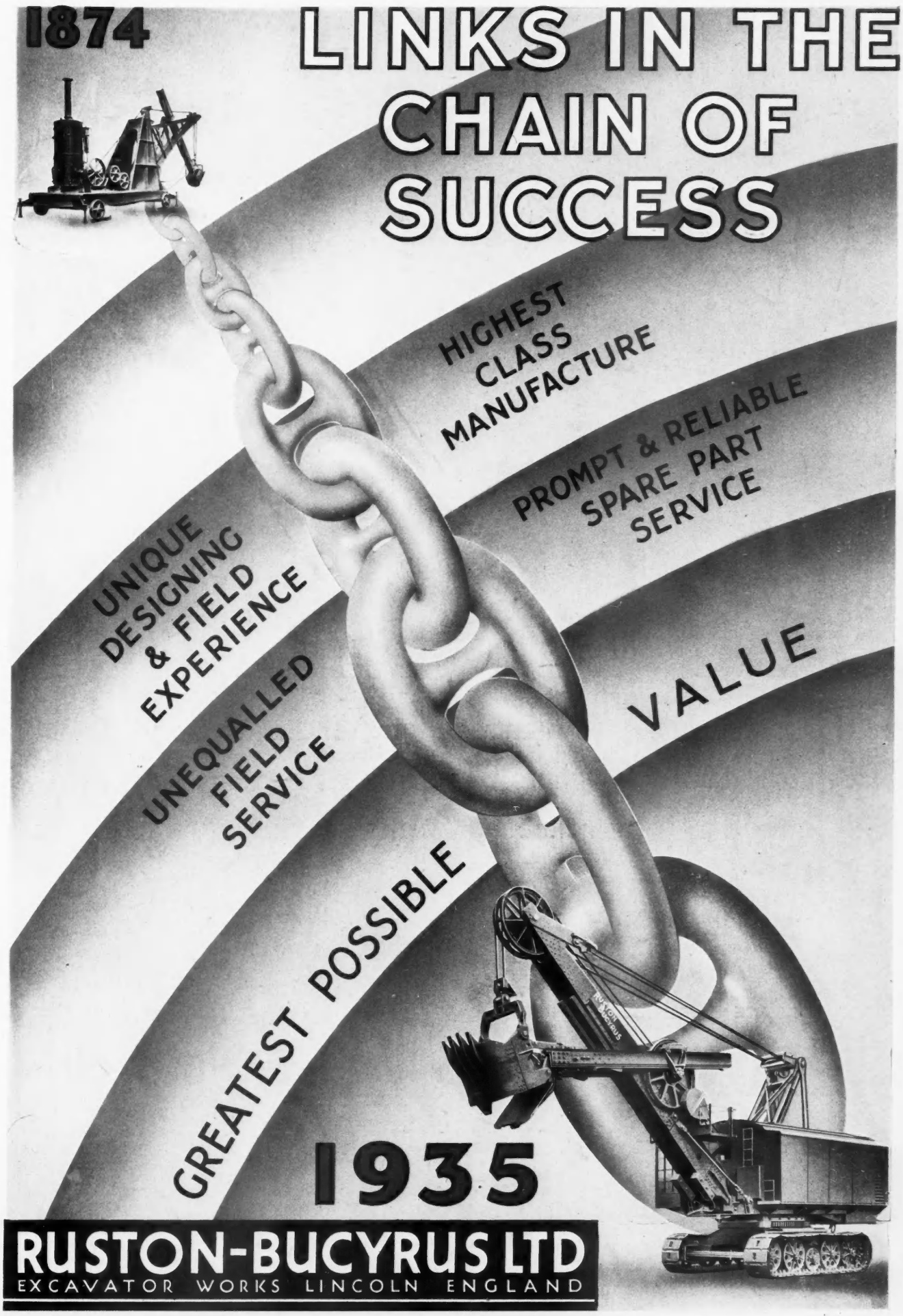

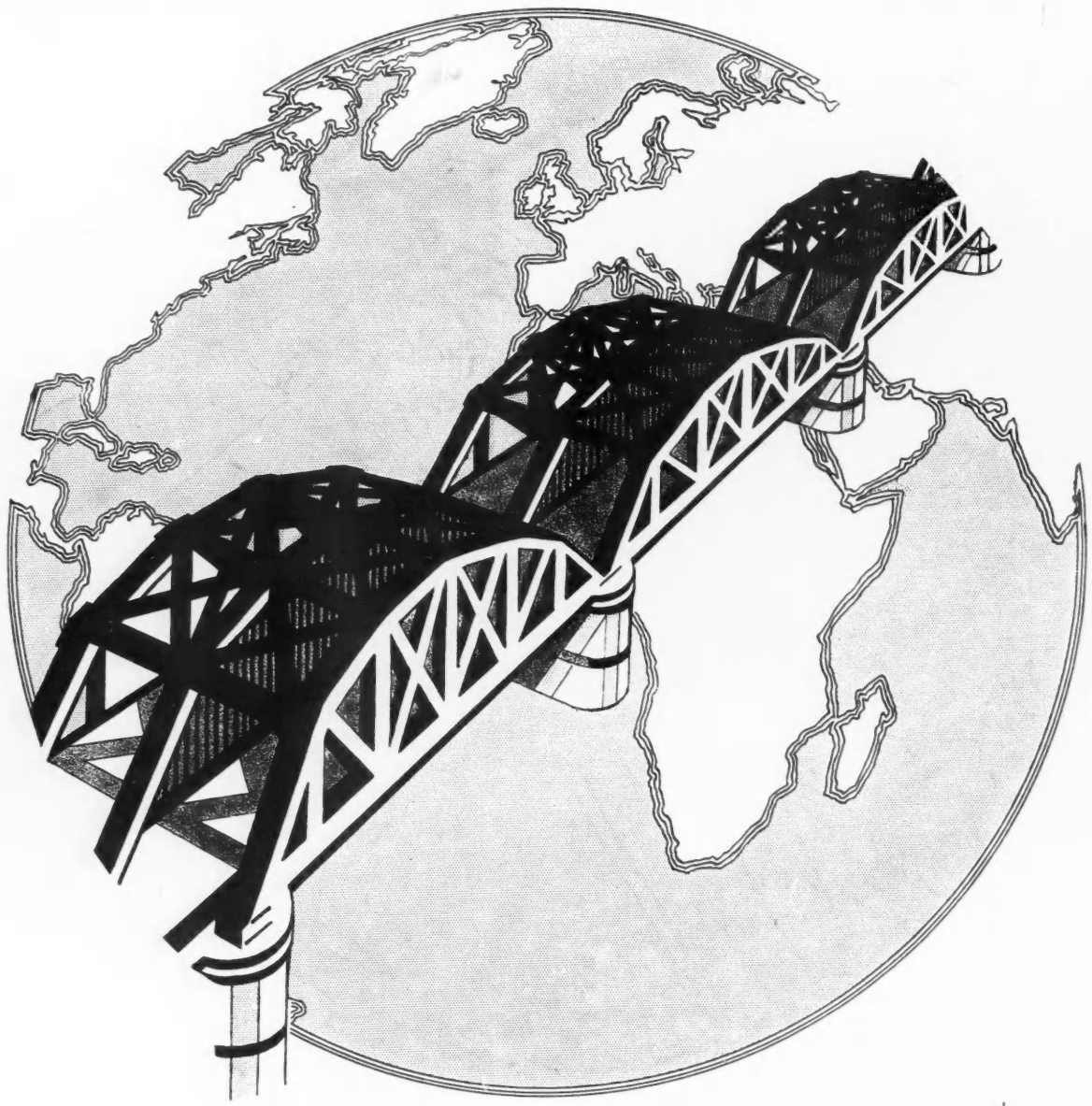

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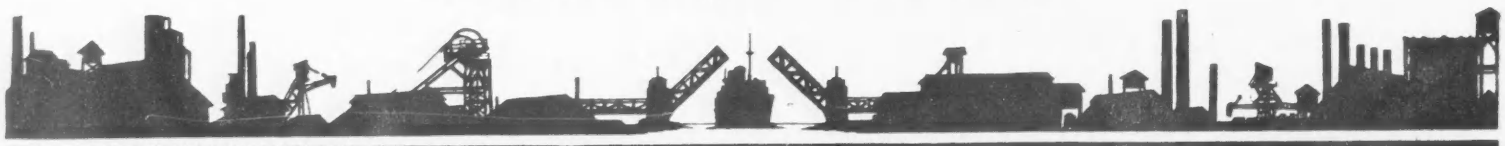


ENGINEERS TO THE EMPIRE

A Seven-Day Journal

The Mottram Marshalling Yard.

THE new Mottram and Dinting marshalling yard of the L.N.E.R., which has been the subject of mention in our annual railway engineering articles for the last three years, was opened on Monday last, October 28th. It is situated about 11 miles from Manchester, and about 8 miles from the western end of Woodhead tunnel and within easy distance of the junction points of Godley and Guide Bridge. The scheme involved a diversion of the main line for ¾ mile, and the yard, which is on the down side of the line and between Dinting and Mottram, covers a distance of 1 mile 26 chains. At the entrance, which is at the Dinting end, there are eight reception sidings, each of which will receive a complete train of eighty wagons. They are on a gradient of 1 in 85 falling towards Mottram, which assists in the flow of the wagons on the shunting hump of 1 in 30, by which they are sorted by gravity into the twenty sorting sidings. The latter sidings are in two groups of ten sidings in a group, each siding holding sixty-five wagons. The hump is 60 yards long, of a gradient, as said above, of 1 in 30, which is followed by 133 yards of 1 in 75, 133 yards of 1 in 100, and 211 yards of 1 in 200. The wagons run out of the reception sidings by gravity and the points of the reception sidings and those leading into the sorting sidings are operated by pneumatic power, controlled electrically from a control tower situated near the bottom of the hump. The control machine consists of a series of push buttons which set the road for any required movement, regardless of the number of points that are concerned. Track circuits are laid in at the points, so that no change in a route can be made until the wagon or wagons of the individual "shunt" have cleared the fouling point.

The French Steel Crisis.

THE failure, so far, to renew the Comptoir Sidérugique de France, or French organisation for the sale of steel products, which normally came to an end on June 30th last and was provisionally prolonged until October 31st because negotiations for a readjustment of production and sales could not be carried through during the holiday season, may affect the international steel situation unless something is quickly done to save the Comptoir. The steel makers' association was formed with the object of maintaining prices on the home market by allotting quotas to producers, who were bound to accept the decision of an arbitration committee of three members in any dispute over the distribution of business. At the same time, sales were effected through merchants under rigid conditions of prices and rebates, and merchants themselves endeavoured to increase their profits by co-operation in holding stocks in the common interest and lowering costs of distribution. This highly organised system worked satisfactorily so long as the demand for steel products kept makers employed, but it threatened to break down when the slump developed, and merchants complained that some producers were underselling them. They applied for a modification of their contract with the Comptoir. There is consequently trouble within the Comptoir over the question of quotas, with which some members are dissatisfied, and over the uncompromising attitude of merchants in insisting upon a more favourable contract. No progress appears to have been made towards a settlement so far, and it is feared that unless the Comptoir is further prolonged to allow of a continuance of negotiations it may collapse. A breakdown would have unforeseen consequences for the home trade and would, it is feared, affect the international steel organisation. It is expected that the French Government will exert its influence to bring about a satisfactory arrangement.

Extensions at the Sculcoates Power Station.

ON Thursday, October 24th, a new 25,000-kW Parsons turbo-alternator set was officially put into service in the Sculcoates power station of the Kingston-upon-Hull Electricity Department by Councillor F. Holmes, Chairman of the Electricity Committee. The turbine is a single-cylinder, duplex exhaust machine, designed for 375 lb. per square inch pressure and a temperature of 775 deg. Fah. For heating the condensate to 260 deg. Fah. the cylinder is tapped at three points corresponding to 42 lb., 17 lb., and 7 lb. per square inch absolute. The second tapping is also led to an evaporator capable of supplying 10,000 lb. of pure make-up water, which is sufficient for the whole station when carrying an average load of 50,000 kW. From the evaporator vapour passes to the low-pressure heater, and after condensing returns to the condenser through the drain cooler. To prevent distortion when starting up or cooling down, the turbine spindle is rotated at a speed of 20 r.p.m. by means of barring gear fitted at the coupling end. Rated at 25,000 kW at 0·8 power factor, the 6600-volt alternator is driven at 3000 r.p.m. through a standard Parsons coupling. Ventilating air is provided by two "Howden" "silent-vane" fans, and a Parsons air cooler in the closed circuit transfers the heat to the circulating water system. In accordance with the latest Parsons practice, the exciter and slip rings are enclosed and included in the alternator ventilation system, whilst carbon dust is removed from the system by viscous filters in the ducts immediately after the brush gear. New switchgear, consisting of the main extra H.T. switch and a L.T. distribution board, was supplied by A. Reyrolle and Co., Ltd., who were also responsible for the control board, Merz-Price protective gear, etc.

The Late Mr. Jonothan Pickering.

BY the recent death of Mr. Jonothan Pickering at his home, 56, Maxwell-drive, Glasgow, at the age of eighty-one, sugar engineers have lost a leading figure who was closely identified with their industry for over half a century. Mr. Pickering was born at New Shildon, County Durham, and served his apprenticeship at his father's Pickering wagon works, now known as R. Y. Pickering and Co., Ltd. When quite a young man he made a voyage to Melbourne in a sailing ship, the "Loch Tay," and returned *viâ* San Francisco. In 1883 he went out to Auckland, New Zealand, where, in 1885, he joined the Colonial Sugar Refining Company. In that same year he visited New South Wales, where he became associated with the Harwood Sugar Mill and later the Broadwater Mill. In 1900 he returned from Australia and settled in Glasgow as the consulting engineer to the Colonial Sugar Refining Company, with which he was closely associated for about forty-five years. During recent years he went to India and revisited Australia. Although closely associated with sugar machinery, Mr. Pickering, who was a member of the Institution of Mechanical Engineers, was keenly interested in all branches of engineering and technical development.

Our National Coal Resources.

IN the course of an address on "Our National Coal Resources," which was delivered before the Institution of Chemical Engineers on Friday evening, October 25th, Sir Harold Hartley paid a warm tribute to the value of the Coal Survey. There was great need, he said, to estimate the extent of our reserves of coal of different types, and this work might well be included in the task of the Survey. The demand for British-produced coal had fallen from 276 million tons in 1923 to 207 million tons in 1933, and had increased to only 221 million tons in 1934. Between 1923 and 1934 the tonnages of British coal sold abroad had fallen by 40 million tons. The percentage of the world's shipping burning coal had decreased from 89 per cent. in 1914 to 52 per cent. in 1934, while export bunker coal had fallen from 23 million tons in 1913 to under 15 million tons in 1934. The consumption of domestic fuel had also fallen from 184 million tons in 1913 to 161 million tons in 1934. Even if our country's manufactures once again were of pre-war type and volume, our consumption of coal, Sir Harold stated, would remain substantially below its former level. That change was caused by such features as the following:—Nearly 15 per cent. less coal was required to produce a ton of pig iron to-day than in 1913; seventeen years ago 3·47 lb. of coal were used to generate a unit of electricity, whereas in 1933 only 1·65 lb. was required; the gas industry had increased its output by 60 per cent. with only 10 per cent. increase in the consumption of coal. The British coal industry, if it did not still dominate the world market, as it did before the war, was, Sir Harold stated, still responsible for 20 per cent. of the world production and for about 40 per cent. of world exports. It had held its position largely through the reduction of costs by mechanisation.

Timber Research.

SOME interesting facts concerning the research work connected with the better use of home-grown or imported timbers are given in the annual report of the Forest Products Research Board, which has just been issued by the Department of Scientific and Industrial Research. The number of inquiries addressed to the Forest Products Research Laboratory at Princes Risborough has risen from 903 in 1932 to 1336 in 1933, and 1739 in 1934. Of these, some 70 per cent. were trade inquiries and the remainder came from Government Departments and educational and research institutions. There was an increase of 45 per cent. in the number of inquiries relating to seasoning problems. Work of economic importance included railway track tests on home-grown timbers for use as railway sleepers, and methods of preservation treatment for prolonging the life of sleepers. With regard to the use of home-grown timbers for pit props, attention is directed to the higher standard of imported timbers attained mainly by the careful preparation of the props and attention to market requirements. A number of researches are in progress on the wood-working qualities of home-grown and overseas timbers. Experiments have been carried out to determine the best shape, setting or speed of tools. Increased need has been shown for tough and hard steel tips, and experiments are being made with a saw tipped with tungsten carbide alloy. Various steel alloys are also to be tested and several saw and cutter manufacturers have offered to co-operate in the work of investigating saw tooth materials and the dulling of planing and other cutters. During the year good progress has been recorded in developing accelerated means of testing the wear-resisting qualities of timbers used for flooring, while a new box-testing machine has been completed. The work of the Laboratory has contributed, it is felt, to the relatively large increase in the consumption of Empire timber, and the facilities of the Laboratory have been employed to their fullest extent.

The "Mauretania Hotel."

SPEAKING at a dinner on the last voyage of the Cunard White Star liner "Mauretania" to Rosyth, where she is being broken up, Mr. J. D. Pollock, the chairman of Metal Industries, Ltd., reminded those present that the ship would continue to live in new machinery and steel plates. By the original idea, however, of Mr. Walter Martin, the chairman of Martins, Ltd., cigar importers, of Piccadilly, the fame of the "Mauretania" will be preserved on shore in a "Mauretania" Hotel, in which the ship's public rooms and regal suites will be incorporated, to be built in New York, and a "Mauretania" block of 200 modern flats in St. Peter Port, Guernsey. Both buildings will be equipped with the ship's furniture and fittings. It may be recalled that Mr. Martin was the principal purchaser of the furniture and fittings and the ship's navigating instruments and name letters. These purchases have been completed by rebuying practically the whole of the public room and cabin equipments in the principal parts of the ship, which have now been reassembled on shore at Southampton and are being prepared for shipment to New York and Guernsey. It has taken, says the *Morning Post*, some 300 men close upon three months to carry out the re-erection of the various rooms in a shed at the Southampton Old Docks, and it is interesting to hear that the dome from the first-class lounge and many other favourite features of the ship have suffered no damage. Mr. Martin hopes that the "Mauretania" Hotel in New York will, in perpetuating the memory of a famous ship, become a centre of English interests.

The Late Professor John Goodman.

IT was with great regret that we learned of the death on October 28th of Professor John Goodman, the occupant of the Chair of Civil and Mechanical Engineering at Leeds University for a period of thirty-two years. He was the youngest son of the late Thomas Goodman and was born at Royston in May 1862. His preparatory training as an engineer covered eight years' practical experience in workshops and a course of instruction at University College, London, and was rounded off by an award of a Whitworth Scholarship. In 1890 he was appointed to the Chair of Engineering at Leeds University in succession to the late Professor Archibald Barr who had left Leeds to take up his appointment at Glasgow University. Under his charge the Engineering Department at Leeds University was considerably enlarged in its scope, much attention being devoted to research work. Professor Goodman's own work on friction, ball and roller bearings, culminating in papers presented before the Institution of Civil Engineers, of which body he was a member, is very well known but it is perhaps less fully realised that the subjects of his research work extended over a wide and diversified range and included investigations on lubrication, crane hooks, air compressors, and live steam feed-water heaters. His name far outside the circle of students whom he taught at Leeds will long be familiar as that of the author of "Mechanics Applied to Engineering," a work which, considerably extended in recent years, is now in its ninth edition. During the war he served as a major in the Royal Air Force and for a considerable time was engaged at a large aeroplane factory in Scotland. In 1922 he retired from his active duties at Leeds University but was appointed Emeritus Professor and was assigned by the University Council special accommodation in which to continue his independent research work.

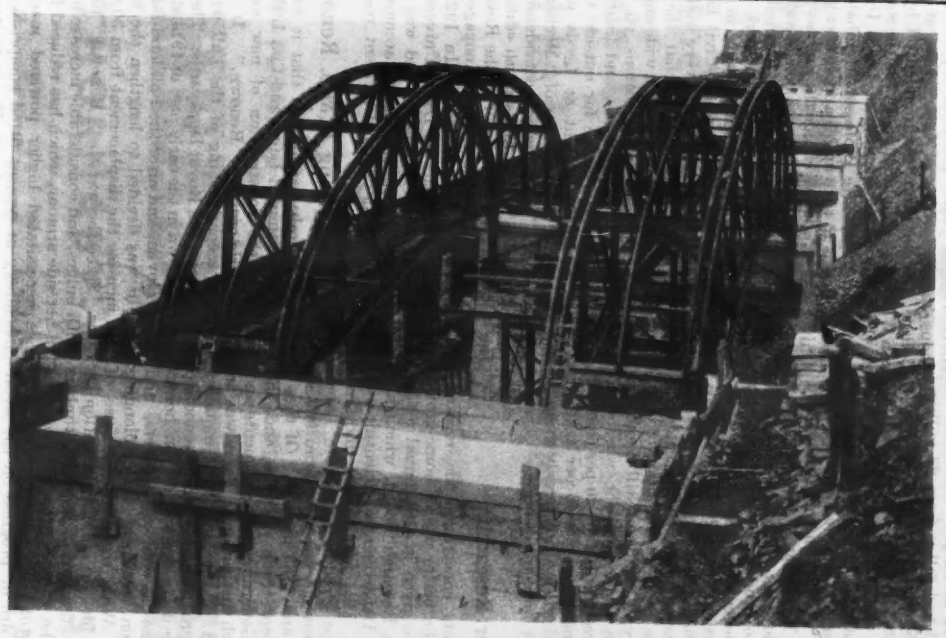
Re-engining H.M.S. Renown.

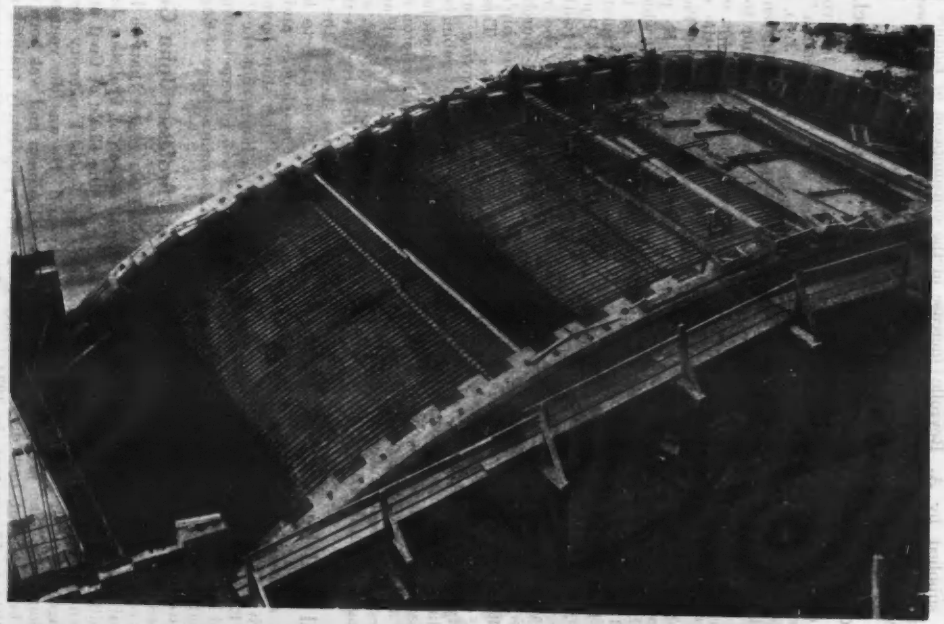
THE Admiralty announces that it has placed an order with Cammell Laird and Co., Ltd., of Birkenhead, for the construction of new machinery for H.M. battle-cruiser "Renown." It is expected that the reconditioning of the hull will be carried out in one of the Royal Dockyards. The "Renown" was laid down in the early part of 1914 at the Fairfield Yard, Govan, and after the Falkland Islands engagement it was decided to lengthen the hull by 100ft. and increase the displacement from 30,000 to 32,000 tons. Since the war the "Renown" has been fitted with bulges, and considerable increase has been made in her side armour, which has reduced her speed and has necessitated higher powered machinery. The machinery at present fitted comprises a quadruple-screw arrangement of Brown-Curtis direct-drive turbines, taking steam from forty-two Babcock and Wilcox oil-fired boilers with a designed working pressure of 250 lb. per square inch. The normal designed output is 110,000 to 120,000 s.h.p., but on trial the "Renown" developed 126,300 s.h.p., corresponding to a speed of 32·68 knots.

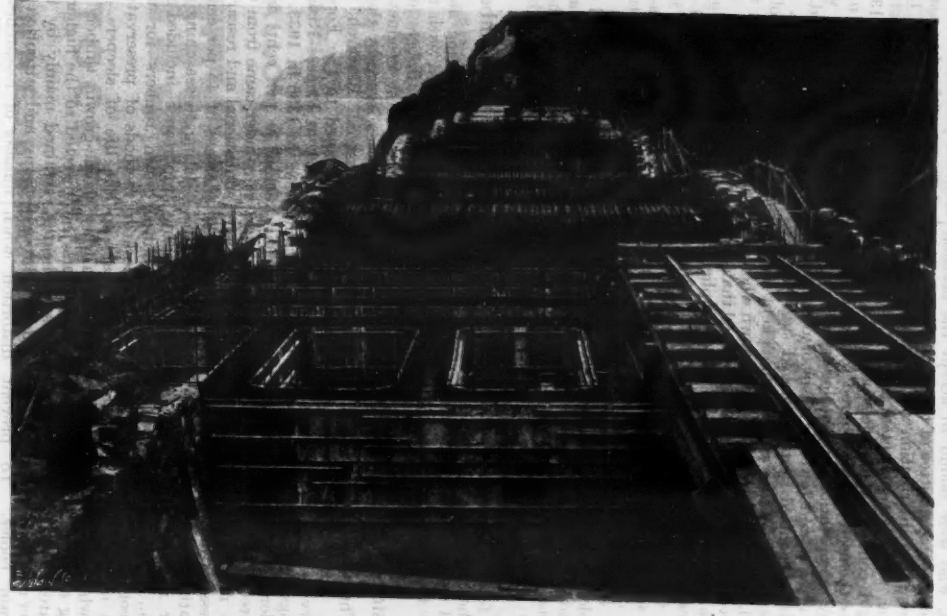
THE CHESTER-HOLYHEAD ROAD, NORTH WALES—ERECTION OF VIADUCT AT PENYCLIP

MESSRS. HOWARD HUMPHREYS AND SONS, WESTMINSTER, CONSULTING ENGINEERS

(For description see opposite page.)





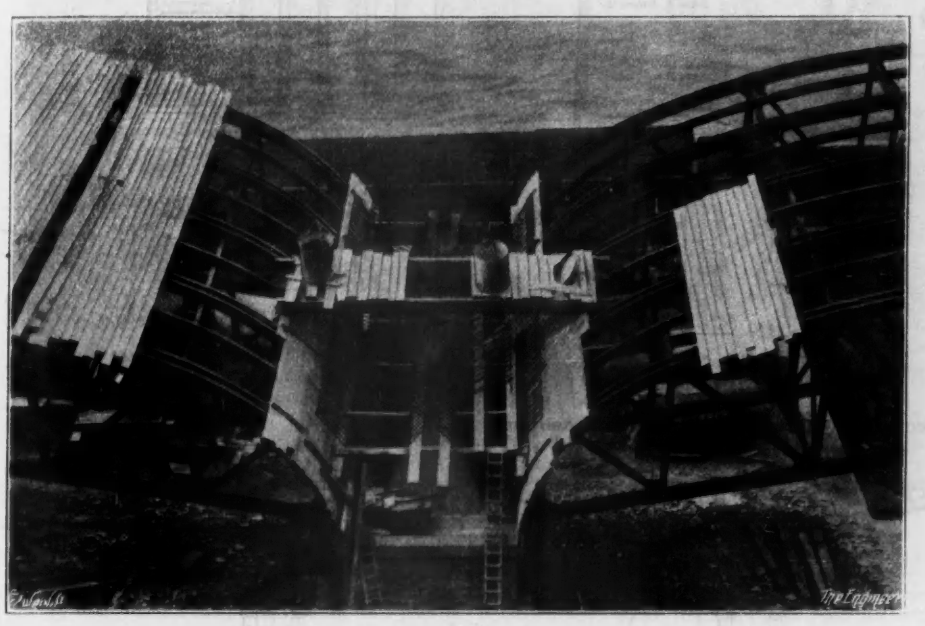


ABOVE:—STEEL CENTRING IN POSITION—JULY, 1933
BELOW:—VIEW FROM THE WEST SHOWING REINFORCEMENT—MARCH, 1934

ABOVE:—VOUSSOIRS IN PLACE AND ERECTION OF REINFORCEMENT—JANUARY, 1934
BELOW:—WORK ON THE DECK APPROACHING COMPLETION—FEBRUARY, 1935

Improvements to Chester-Holyhead Road.

IT is our fortune in the British Isles to have no such barriers as the Alps or Pyrenees across which to fling great arterial roads. Even where mountainous country does exist there is, in general, no demand for roads of other than a secondary character. Nevertheless, particularly in Scotland and in Wales, there are districts in which for short distances Nature has opposed to the skill of engineers conditions which render the construction of roads as difficult as it is in much more mountainous countries abroad. A particular instance of such conditions is provided by that part of the Chester–Holyhead road which lies between Conway and Llanfairfechan, and which in an endeavour to avoid crossing the main Snowdon mountain range skirts round the northern coast of Wales. At two points in the 8 miles between the two towns mentioned the mountains project into the sea in headlands, named respectively Penmaenbach and Penyclip. In a bay between these headlands there is situated the town of Penmaenmawr. The road around the coast, and particularly that around the Penyclip headland, has again and again required to be rebuilt. No Roman road appears to exist, for the Romans, rather than undertake so arduous a task, carried their road inland over a pass at 1400ft. above sea level. Historically, the first mention of a road, or rather track, attributes its maintenance to a hermit, Seiriol, who lived in the sixth century. Even by the time of Charles I the track was "scarce a yarde and a quarter or a yarde" wide, and was slung high up the mountain side. The first road of any width appears to have been constructed at the instance of the Duke of Ormonde in 1720, and was situated lower down, but its maintenance in the face of rock falls from above and erosion from the sea was so difficult that fifty years later Dr. Johnson, on one of his journeys, could write in relief that so dangerous a passage was behind him. Not until 1811 was the road put again into a decent state of repair. At that date Thomas Telford was appointed by the Government to improve and reconstruct the old mail coach road, and he built the fifth of a succession of roads which can be traced on the hillside, and at the same time erected the suspension bridges over the Conway River and the Menai Straits, the former of which has recently been condemned to be demolished. The railway age was now approaching, and in 1846 another famous engineer, Robert Stephenson, was engaged in constructing the Chester–Holyhead Railway to follow the same general line as the road around this coast. He kept his line close above high tide mark, and just to the west of the Penyclip headland he intended to carry it on a massive sea wall at the base of the mountain across a shallow inlet now known as Viaduct Bay. A violent storm, however, not only broke gaps 30 yards wide in this partly completed wall, but also carried away some 3500 cubic yards of backing material. Drawing the moral from this accident, Robert Stephenson carried his line across the bay on a viaduct which was equally unaffected by erosion from the sea or falls of rock from the mountain above. His viaduct still exists, and can be seen in the engravings in a Supplement to this issue. Telford's road, however, despite the skill with which it had been constructed, could not stand up to the conditions at this point, and it was necessary to rebuild it higher up the hillside. Moreover, quarrying at the top of the mountain now added a further danger, for spoil was tipped on the hillside and threatened at times to slip down on to the road. In 1899 the effects of erosion by the sea had become so serious that the advice of Sir Benjamin Baker was sought, and he recommended the construction of a sea wall and some massive stone pitching, which was subsequently built, and is shown partly constructed in an engraving on this page. It is worth noting that the height of the pitching is 73ft. The precarious character of the slopes is also shown in this view. Despite all this work the old road that was in use up till a few weeks ago had a maximum gradient as great as 1 in 11, and a width between walls in some places of no more than 14ft. The Chester–Holyhead road is much used for industrial traffic, and when over and above that there was added during the summer months a heavy load of tourist vehicles, the congestion on so narrow a thoroughfare can well be imagined. Queues frequently extended back on each side as far as Penmaenmawr and Llanfairfechan respectively. The only alternative road that exists involves a detour with an additional 18 miles through Bettws-y-Coed and over the Nant-francon Pass.



CENTRING AND REINFORCEMENT ABOVE PIER

SEA WALL AND STONE PITCHING

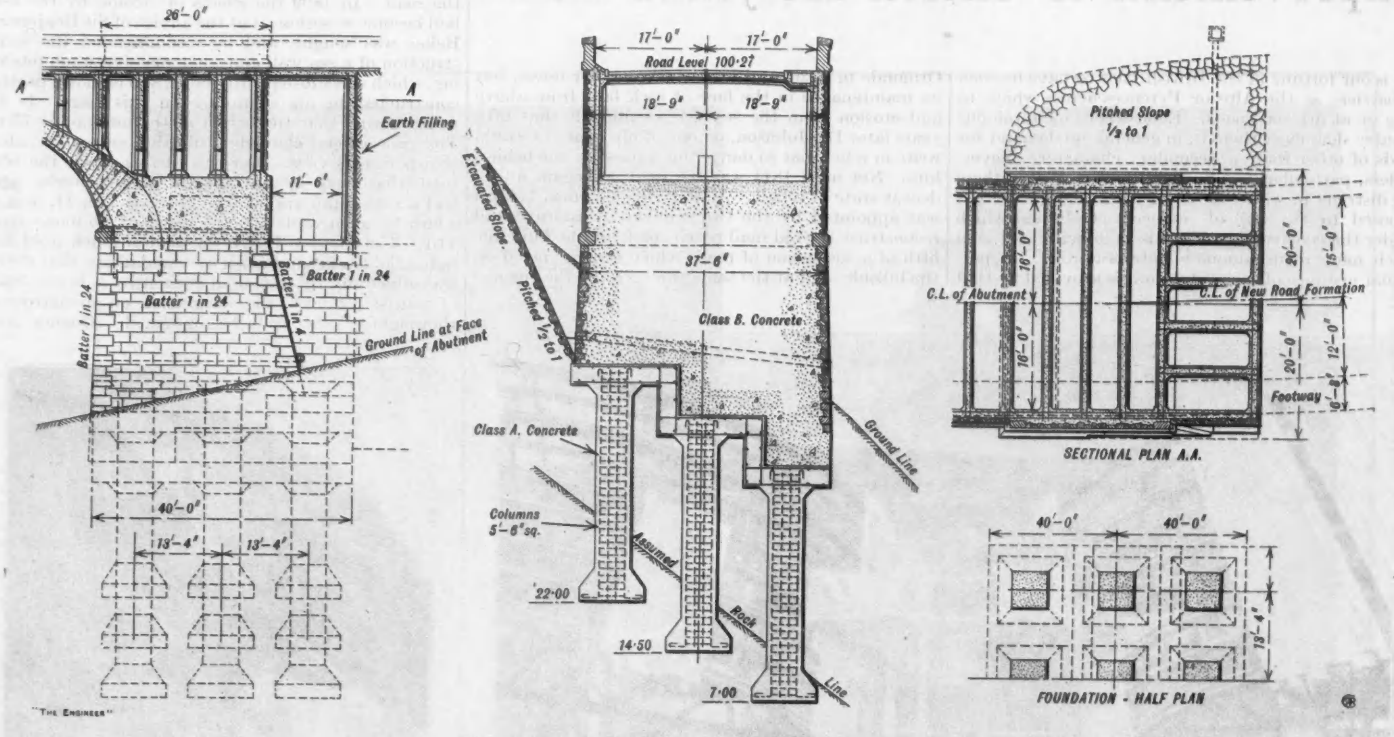
CONCRETE "BUTTRESS" AT TUNNEL PORTAL

CONCRETE SUPPORTING ARCH AT TUNNEL PORTAL

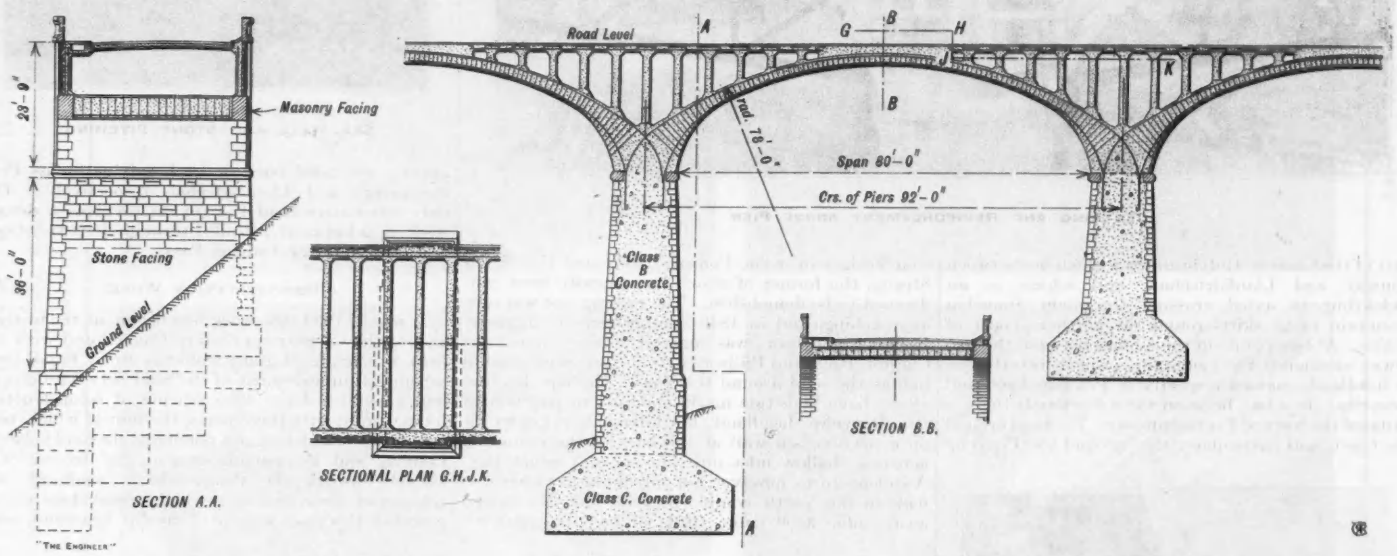
Reconstruction Work.

It was in 1930 that work was begun, at the instigation of the Caernarvon County Council and with the help of a financial grant from the Road Fund, on a scheme of improvement of the road between Conway and Llanfairfechan. The scheme of reconstruction fell naturally into three parts, the first of which, consisting of the widening of a portion of the road between Conway and Penmaenmawr and the driving of a tunnel through the Penmaenbach headland, was completed some time ago. The second stage works, carrying the road around Penyclip headland, were recently completed and were opened by the Minister of Transport on October 5th. The third stage, which yet remains to be begun, consists of road widening on towards Penmaenmawr. It was at one time suggested by the consulting engineers to the schemes, Howard Humphreys and Sons, of 17, Victoria-street, Westminster, that all the difficulties that had been encountered by earlier road builders at Penyclip could be avoided by tunnelling through

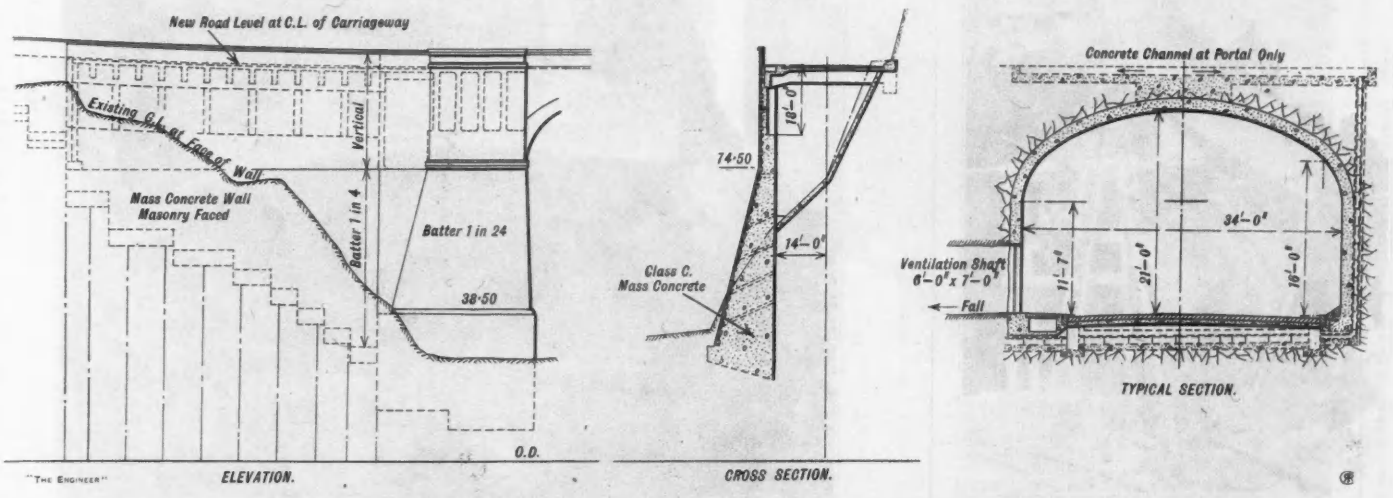
CONSTRUCTION OF VIADUCT AND TUNNELS AT PENYCLIP



SECTIONS AND DETAILS OF WESTERN ABUTMENT



ARRANGEMENT OF PIERS



ELEVATION AND SECTION OF EASTERN ABUTMENT AND TYPICAL SECTION THROUGH TUNNEL

the headland in a manner similar to that adopted at Penmaenbach, but for a greater distance. The road, however, is used, particularly in summer, by a large amount of tourist traffic, and it was felt by the Council that nothing should be done which might reduce its scenic value. Consequently, an alternative scheme was developed for widening the existing road between Penmaenmawr and Llanfairfechan at each end, and for carrying a new road around the headland and across Viaduct Bay through two short tunnels and over a viaduct. The relative positions of the completed viaduct and the two tunnels, Telford's road, and the road which the viaduct will replace, together with the railway bridge, can be seen in an engraving in the accompanying Supplement. It is interesting to observe that road engineers have now been forced by the conditions at the site to adopt exactly the same expedient to meet them as Robert Stephenson adopted nearly ninety years ago for the railway.

The Road Generally.

The old road, under the scheme as planned, was to be widened from Penmaenmawr to the beginning of the new construction, and from the end of the new construction for about 450ft. towards Llanfairfechan. To date, only the work on the latter has been finished. In carrying out the work, the mountainside had to be excavated, and it was found necessary to support it by a heavy retaining wall. The new approach road to the viaduct on this side is about another 500ft. long, and is supported on the sea side by a massive retaining wall as high at one point as 64ft. from foundation to coping level, with a base 25ft. wide. Between the tunnels on the eastern side of the viaduct, about 500ft. of new road has been hewn out of the rock, and extensive facing work was found

BLAST FURNACES AND ORE YARD AT THE CORBY WORKS

necessary here to ensure that rocks should not fall on to traffic using the road. Beyond the tunnels there is a further section of new road which eventually joins up with the old road. In forming this part of the work a very deep gully had first to be filled in by a retaining wall with a maximum height of 74ft., and the ground behind was then built up to road level. The new road has a maximum gradient of 1 in 20. Its carriageway is 27ft. wide, and there is a 5ft. pathway on one side.

The Tunnels.

The two tunnels are identical in section and have the same dimensions as that at Penmaenbach. A typical sectional drawing is reproduced on page 448, and several photographs reproduced herewith, on page 447, and in the Supplement show stages in the work of construction. Both tunnels are concrete lined, and each has a maximum headroom of 21ft. That on the west is 115ft. long and the other 180ft. Certain difficulties were encountered in driving them, not only from the shattered nature of the rock, but also from the proximity of the railway below and the old road above, the existence of which indeed prevented the use of straightforward cuttings. The eastern tunnel was rendered necessary by the fact that at this point, known locally as the "Clip," the old road passes almost immediately above the new, as can be seen in the Supplement engraving. It will be realised that to make a cutting at this point would have required the diversion of all traffic using the road for a period much longer than it was possible to tolerate. It will be seen in the same engravings that the other tunnel passes through an outjutting piece of rock. Tunnelling was adopted at this point because of the fear that if a cutting was attempted much rock might be caused to fall on to the railway below and the existing road might be endangered.

The driving of the tunnels was no easy task. Some idea of the sort of difficulties encountered can be gained from two engravings on page 447. Both show concrete structures erected to support the rock at portals lest when tunnelling was begun serious falls might occur. No sign of these structures is visible in the completed tunnels. In driving the heading for one of the tunnels it was found that there existed just at the centre of what was to be the roof a great fissure in the rock. Its existence necessitated that special provision should be made for the support of the roof while the tunnel was being opened out to size and concreted, and the method employed is illustrated in the Supplement. With the exceptions provided by the measures adopted to meet these various difficulties, there was nothing unusual in the methods used for driving the tunnels.

The Viaduct.

Unquestionably the most interesting part of the work is the viaduct, progress in the construction of which is illustrated in several engravings on pages 446 and 447 and in the Supplement. The design of this work is shown in drawings reproduced on page 448. Despite its appearance, the viaduct is, in fact, a monolithic concrete structure. The piers are of mass concrete, and the arches are of reinforced concrete. The piers and arch spandrel walls are faced with Penmaenmawr stone from the local quarries, while the pier quoins and the arch voussoirs are of precast blocks made of local stone aggregate and aluminous cement. The intrados of the arches are unfaced. The roadway is carried on a reinforced concrete deck and surfaced with tarmacadam. The reasons for constructing a viaduct at this point will have been sufficiently appreciated from the historical review with which we opened this article. Before the building of the structure was begun extensive exploration of the subsoil was carried out by means of bore-holes and adits into the mountain. Considerable differences were found in the foundation material. At the eastern end disintegrated rock at a shallow depth provided a good foundation. Brownish shale, apparently derived from disintegrated rock, exists beneath the centre piers. But the subsoil at the western end is a blue shale. These differences of foundation material, together with variations in the contours of the mountainside, have caused the designs of the foundations of the abutments at each end to be different. At the eastern end the abutment is partly formed by the mountain itself. On the outer side, as shown in one of the drawings, a concrete wall has been built up to support concrete beams, which are carried at their inner ends by the rock. The height of the wall and the length of the beams vary in accordance with the shape of the mountain. The western abutment, however, stands further aside from the mountain, and is supported, as it were, on nine "stilts." No special difficulties were encountered in making the excavations for these pillars, but it is interesting to note that in concreting them at a later stage pipes were embedded through which grouting of the subsoil was subsequently carried out. This work was delayed until a time shortly before the centering was removed, in order that the piers and abutments should be carrying as great a dead load as possible before the grouting was undertaken. Perhaps it was as a direct consequence of this delay that no measurable settlement in any part of the structure was observed when the centering was removed.

Concreting of the viaduct was carried out by the aid of two steel towers, one at each end, having a cableway slung between them. When the piers had been built up to the height of the springing of the arches steel centering was placed in position. Wooden lagging was laid across the centering to take the concrete, and the precast concrete voussoirs were then placed in position on each side. While this work was in progress the building up of the reinforcing bars from the tops of the piers had been begun, and the interlacing steel rods above one of the piers are well shown in an engraving on page 447. As soon as sufficient reinforcement was in position concreting began, and the work was continued to the design shown in the drawings. Arrangements have been made to permit access to be gained to the large hidden voids beneath the roadway above each pier for inspection purposes. The maximum height of the viaduct above foundation level is 93ft., and it carries a roadway 27ft. wide with a pathway 5ft. wide on one side.

In conclusion, we wish to express our indebtedness to Messrs. Howard Humphreys and Sons, the consulting engineers to the scheme, for providing us with the material upon which this account has been based, and with the photographs and drawings which illustrate it, and to congratulate the Caernarvon County Council on having achieved a satisfactory solution to a problem many hundreds of years old.

Corby Iron and Steel Works.

No. I.

WE have already referred on more than one occasion to the new works of Stewarts and Lloyds, Ltd., at Corby, in Northamptonshire. They have been specially designed and equipped to supply basic Bessemer steel for the company's new tube works, which have been built on the same site, and, in addition, to supply iron and steel in various forms to the outside market. These works, as our readers are aware, are situated near Kettering, in the centre of the company's large iron ore reserves, and they occupy an area of about 350 acres, excluding the ore fields which extend over many square miles.

The iron ores of Northamptonshire are of a low-grade carbonate type, with an iron content ranging between 29 and 32 per cent. of metallic iron. They occur in flat beds averaging from 8ft. to 10ft. in thickness. The beds contain over 1500 million tons of ore, forming one of the world's largest iron ore deposits. But it was not until the beginning of operations in these new works that steel was made at all in the district, although foundry iron has been produced in Northamptonshire for many years.

There were reasons for not developing a steel industry in Northamptonshire earlier. The high phosphoric content of the ore when used by itself makes an iron too high in phosphorus for economical steel production by the open-hearth process, and the high sulphur and alumina content of the ore, coupled with its extreme fineness, made the manufacture of low silicon basic Bessemer pig iron very difficult. The failure to produce this particular quality of iron from the Cleveland ores in Middlesbrough was

again a strong deterrent against risking such an enterprise in Northamptonshire.

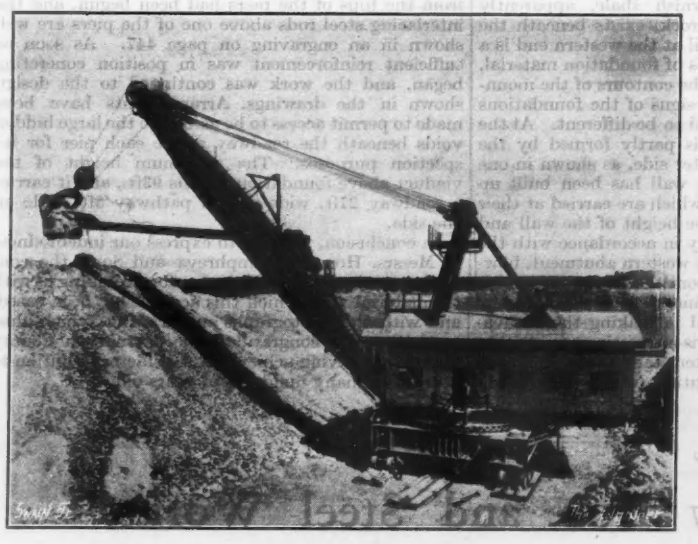
The plans for the new Corby works were first discussed early in 1930, but it was for various reasons only towards the end of 1932 that the scheme was ready for putting into operation. The design of the whole plant and supervision during construction, also the charge of the operation of the iron and steel sections under the direction of Stewarts and Lloyds, was entrusted to Mr. H. A. Brassert, of H. A. Brassert and Co., Ltd., of Walbrook, London. Alongside the problems of design and construction

The Works and Plant.

The plant at Corby consists essentially of an ore-treating plant, specially designed to cope with the irregularities of ores, both physically and chemically; a modern blast-furnace installation of three units, two of which are now in operation, and the third is now completed; a coke plant, comprising thirty-five cross-over, flue type coke ovens, with coal-washing and complete by-product plant, including four special horizontal coking ovens for the manufacture of high-grade coke from non-coking coal; a basic Bessemer plant of new design, consisting of

The Three Blast Furnaces

was the necessity of completing the new plant as soon as possible. Instructions to proceed with the plans and drawings were received by Mr. Brassert on January 1st, 1933, and the preparation of the site and the excavation work was started in March, 1933. The foundation work was done by Shanks and McEwen, Ltd., and the F.C. Construction Company, Ltd. The first blast-furnace, No. 1, was started on May 8th, 1934, most of the steel constructional work



Ransome Electric Stripping Shovel

Ruston Ore Digging Shovel

being carried out by Ernest N. Wright; Ltd., of Wolverhampton; No. 2 followed six months later in November, and the first heat of steel was blown on December 27th, 1934. The blooming mill and strip mill were started in January, 1935. It may be pointed out that the new blast-furnaces had to be built in place of three existing foundry iron furnaces, the old plant being kept in operation while the new plant was being constructed. Although a very difficult task, operations were carried on without any loss of production. The first pig iron was made within a year and three months, and the first steel was rolled in less than two years from the date of breaking ground. We are able to state that the problem of utilising Northamptonshire ore has been solved.

an inactive hot metal mixer and three converters; rolling mills, including soaking pits, a heavy blooming mill, reheating furnaces, and a strip mill of the semi-continuous type for rolling strip for the tube works, together with the necessary auxiliary plant and equipment, which includes steam, power and water supply, engineering workshops, phosphate slag plant, and administrative and office buildings.

The engravings reproduced on page 456 show the general lay-out of the new plant, while on page 449 and above we illustrate the new blast-furnace plant.

Ore-mining Operations.

The iron ore for the Corby operations is found in close proximity to the new iron and steel works. It is in general of the carbonate type, and is relatively high in phosphorus, being very similar in characteristics to the famous minette ore of Alsace and Lorraine, on which, on the Continent, the great basic Bessemer steel-making industries have been established. The overburden varies from a few feet to over 70ft. In the area where the overburden is heavy, the iron content averages from 29 to 32 per cent., and the ore is almost entirely of the carbonate type. In those areas where the overburden is relatively shallow, the ore bed has become oxidised by weathering with decomposition of the carbonates and enrichment of the iron content to 30 to 35 per cent.

At the present time, over one million tons of iron ore are being mined per annum by Stewarts and Lloyds from four major mining operations. The mining is carried out by the normal open-cast method, and in one mine there is a new electrically driven baring digger with a bucket of 9 cubic yards capacity. This digger—see below—is the largest of its type to be installed in the world, and was designed and built by Ransomes and Rapier, Ltd., of Ipswich. Our engraving shows the machine discharging to the spoil heap. It is followed by a smaller digger for the recovery of the ore bed itself, which we also illustrate below. It is of the Ruston-Bucyrus pattern, and has a capacity of 3 cubic yards. Its duty is to lift and load the ore after the bed has been shaken by light blasting. The same engraving clearly shows the work of the 9 cubic yard machine in removing the 70ft. overburden.

Ore Treating and Handling.

The ore-treating and handling plant was built and erected by Mitchell Engineering, Ltd., of London. It comprises crushing and screening equipment and is fed from a marshalling yard which receives the ore direct from the various open pit workings, which are at present less than a mile away. The ore is graded and delivered to the crushing plant in a definite rotation according to a predetermined schedule to meet the considerable variations of the ore from the different workings. The delivery to the electrically driven wagon hoist which feeds the crushing plant is by gravity, as is the return of the empties to the marshalling yard. The wagon hoist discharges the ore into two moving screens specially designed to take out before crushing all ore below a certain size, and particularly the brown weathered ore, which is of a different analysis than the hard green ore. These screens have been designed to function in wet weather, which renders the Northamptonshire ore extremely sticky. The ore which passes through the first or main crusher is recrushed in a secondary crusher down to 3in. to 4in. size. Both crushers are of the roll type, and were supplied by Hadfields Ltd., of Sheffield.

The whole of the ore then passes through the screening plant, where all the fines below ¾in. are screened out; the ore fines are stored in a line of bunkers feeding a conveyor belt on which they are mixed with coke fines, flue dust, and roll scale, and carried to the sintering machine. The larger sizes pass to the graded ore bins, which discharge them into an electrically driven transfer car which dumps the ore either into the ore stock pile or directly into the blast-furnace bins.

Ore Bridge and Bins.

The blast-furnace ore yard, see page 449, is spanned by an electrically driven ore bridge with a total lifting capacity of 20 tons. The transport bridge, which was built by Thomas Broadbent and Sons, Ltd., of Huddersfield, in collaboration with the Demag Company, is supported on two legs placed on 140ft. span rail centres. One of the legs is fixed for taking all end thrusts, and is 32ft. long, whilst the other leg is of the pendulum type hinged at the top; it has a length of 35ft. Both legs are open to enable the trolley to pass through and work on the cantilever extensions at each end. The grab is of the Demag bucket, three-motor type, having a capacity of approximately 12½ tons of ore, and by means of a special arrangement of the hoisting machinery the grab can be opened at any height and hoisted in the open or closed position. The ore bridge runs on two walls built of ferro-concrete. The inner wall carries an overhanging track from

which transfer cars and wagons can dump into storage. This wall, together with the bin walls, forms a protected driveway from one end of the blast-furnace plant to the other, permitting convenient delivery of materials by motor car or lorry. The whole of the concrete construction work was carried out by Christiani and Nielsen, Ltd., of London.

The blast-furnace bins were designed and built by Sir William Arrol and Co., Ltd., of London and Glasgow. They are of heavy steel construction and discharge through gates of a special type to enable handling very sticky ore without undue difficulty. Two tracks cover the ore bins so that materials in railway wagons, as well as transfer cars, can be handled without interference. The coke is brought direct from the coke plant by belt conveyor, and is discharged into double coke bunkers situated above each skip pit. Shuttle belt and bins are designed to minimise abrasion. The coke is screened in a screening station placed on the conveyor belt.

SINTERING THE ORE.

The sintering plant, built by Huntington, Heberlein and Co., Ltd., of London, consists of a Dwight-Lloyd single-strand machine, 72in. wide, having a capacity of 750 tons of sinter per twenty-four hours. It is equipped with the necessary mixing and pugging equipment, from which the sinter mix is fed on to the machine by means of a swinging spout. The bed is then ignited by a specially designed blast-furnace gas burner, the suction being obtained from a 100,000 cubic feet capacity multi-vane fan. The finished sinter is loaded into a special storage bunker and is transferred to the blast-furnaces by means of the electrically driven ore transfer cars mentioned above. In the sintering operation about one-half of the sulphur content of the ore can be eliminated by a special method of operation as well as all of the CO_2 and water. The iron content is raised from 31 per cent. in the raw ore to about 42 per cent. in the sinter, which chemically, as well as for its physical conditions, is a desirable ingredient in the blast-furnace burden.

(To be continued.)

The Motor Show at Olympia.

No. III.

(Concluded from page 426, October 25th.)

AUXILIARY EQUIPMENT SECTION.

As the popularity of motoring increases, and especially as motoring becomes more a matter of business necessity and less a matter of pleasure, so does the importance of the maintenance and repair work increase. No longer can the average motorist leave his car in a garage for "a week or ten days," at intervals for decarbonisation and valve grinding, resigning himself simply to a week-end without the customary drive. Instead, the average motorist of to-day needs his car as part of his personal business efficiency or even as a part of the equipment, without which his business cannot be carried on, as in the case of doctors, travellers, managers of multiple stores, demonstrators, &c. He demands that his vehicle be as regular in its "business attendance" as he is himself and that all the attention that it gets be given to it "out of office hours." Arising out of this necessity comes the modern service station, where every item of equipment is designed to perform a particular duty in the minimum possible time. No longer do mechanics grovel beneath a car or wait for one operation to be completed before the next is begun. The car enters a service garage, is lifted from the floor on to a platform, and receives the attentions of numerous specialists, each equipped with the very latest jigs and quick-acting tools designed to perform one operation in the most rapid possible way. The equipment of such a service garage must obviously be of the best and also be power operated wherever possible, so that in general and in detail it represents one of the best examples of the modern workshop, as fully automatic and as completely mechanised as man's ingenuity can make it.

As a large portion of maintenance work is fitting, it follows that the fitting tools come first in the general speeding up, and in this line the use of compressed air is usual. Air-operated hammers, chippers, grinders, and files, screwdrivers and spanners are all available to shorten the time of fitting and assembly.

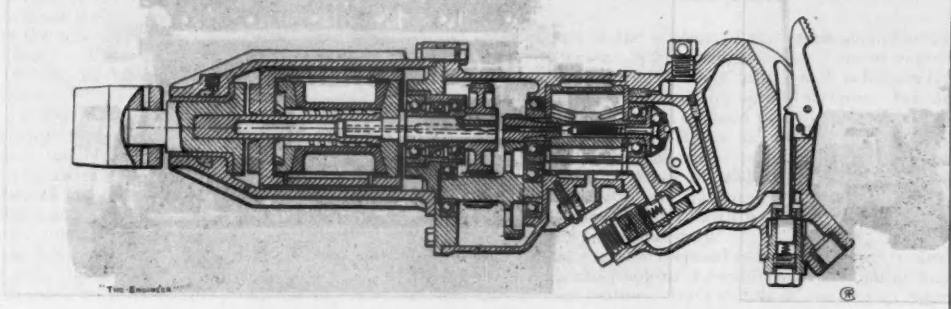


FIG. 26—PNEUMATIC IMPACT WRENCH—INGERSOLL-RAND

The Ingersoll-Rand Company, Ltd., of 165, Queen Victoria-street, E.C.4, has long been specialising in pneumatic machinery. On its stand at Olympia this year there was a complete range of single-stage and two-stage air compressors, which have been designed and built to meet the requirements of modern garages and service stations. A complete range of two-stage air-cooled compressor units was shown, some of which were in operation in order that their many advantages might be more readily brought to the notice of interested parties. These machines are capable of compressing air to any maximum pressure up to 200 lb. per square inch, and are available in capacities from 6·5 to 41 cubic feet per minute.

Catering for the garage requiring only small amounts of air at pressures not exceeding 150 lb. per square inch there were shown three sizes of single-stage machines of $\frac{1}{2}$, $\frac{1}{4}$, and 1 h.p. Typical examples of paint spray outfits were displayed, and a 5 h.p. single-stage compressor for 100 lb. duty was used to operate a number of small pneumatic tools A new tool was the Ingersoll-Rand pneumatic impact wrench. The action of this wrench combines rotative movement with a hammering effect, and enables nuts to be run on and tightened down more effectively than could be done by a long-handled hand wrench. As the tool is reversible, it will strip nuts which are very badly rusted and in such a condition that otherwise they would have to be cut off by means of a hammer and chisel.

The tool is constructed as shown in Fig. 26. It consists of four parts. The motor unit with the handle and casing similar to that used in the firm's drills forms the first part. Within the continuation of the casing the other three parts, the accumulator, hammer, and anvil, are housed. The two parts of the cover are separated by a cover plate, so that the impact unit is separated from the motor unit entirely. The accumulator, which is the heart of the mechanism, consists of a fluted hollow cylinder of tempered rubber with a standard type of driving mechanism vulcanised to one end to engage the spindle of the motor unit. At the other end jaws are provided, which engage with the hammer unit. The hammer is a cylindrical weight which carries on its lower end two impact jaws resembling a two-jaw dog clutch. These two jaws loosely engage similar jaws on the anvil, a part having jaws at one end and tapering off at the other to form a square driving end to take snap type chucks. An arbor locates the anvil and guides the hammer. In operation, when a suitable nut chuck has connected the machine to the nut to be tightened, power is applied and simple torque is transmitted through the machine from the motor unit to the nut, which is run up the stud or bolt till tight. When the nut stops a twist is put on to the accumulator by the torque of the motor unit. The accumulator then shortens under the twisting effect and the hammer is pulled away from the anvil until their respective jaws are pulled apart. Immediately the accumulator untwists and lengthens, causing the jaws to re-engage in the next position available with a powerful impact. This process produces a hammer blow on the nut, which may be repeated two or three times until the nut is considered tight. By means of this tool we understand, the hardest "frozen" nut can be removed with a few blows, so that discretion should be exercised when tightening up, a specified number of blows being laid down for each job. Incidentally, equal tightness can be assured for such assemblies as cylinder heads, pipe joints, &c., where evenness of tension is desired.

The requirements of the modern automobile body designer with regard to such matters as chassis height, width, or length, have nowadays to be met by the designer regardless of the requirements of "accepted" design. If a car has to be hung lower than normal, such parts as the differential must be designed to "fit in" even if a new design of gearing has to be prepared. In Fig. 27 a worm gear differential unit, produced by David Brown and Sons (Huddersfield), Ltd., is shown. It is a unit which combines high reliability with dimensions which enable it to be fitted to the low-hung modern chassis without any tunnel or other interference within the body space. Complete rear axles fitted with this unit are also made. Primarily designed as an underslung worm drive, the unit may be reversed with only slight modification if necessary. The gear housing is a self-contained unit containing all the bearing seatings for both worm and wheel. The unit has, therefore, no loose bearing caps, is rigid, can be machined with great accuracy, and assembled easily. The worm wheel is carried on two bearings, while the worm shaft has three. The differential is of the four-planet type, the bevels being spherically seated on a star piece. While Fig. 27 illustrates the torque tube model, the unit can be adapted for open propeller shaft drive. The aluminium housing is made in halves joined by high-tensile steel bolts. The top half has a spigot registering with the axle banjo. The worm

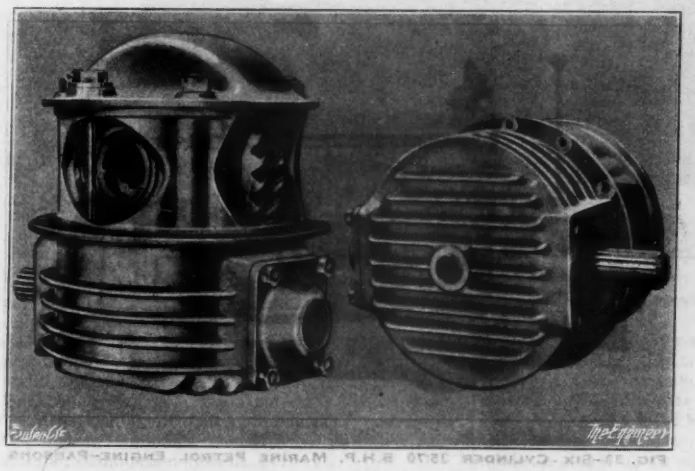


FIG. 27—WORM GEAR DIFFERENTIAL UNIT—DAVID BROWN

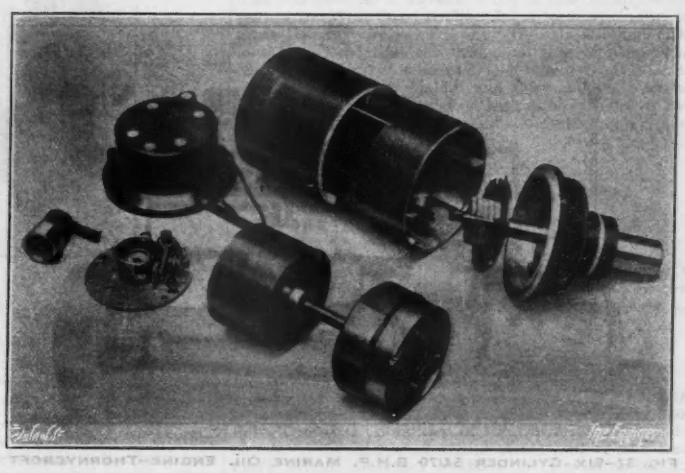


FIG. 28—SCINTILLA "VERTEX" MAGNETO

shaft is a 3½ per cent. nickel steel forging, case hardened and heat treated, and the threads and fitting parts are ground. The worm wheel is of a specially developed high-tensile alloy known as "Taurus" bronze, centrifugally cast. The worm shaft is mounted at the rear end in a single-lip roller bearing carrying the radial load, and a duplex bearing carrying the axial load. A single-lip roller bearing carries the forward end. In Fig. 28 is illustrated a

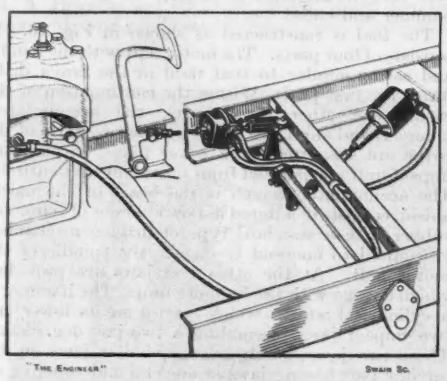


FIG. 29—BENDIX POWER BRAKE DEVICE

Scintilla "Vertex" magneto dismantled. This machine is not new, but it represents a development from the conventional magneto.

The rotating portion consists of a shaft to which are attached a rotating permanent magnet, a contact breaker cam, and a distributor arm. It is driven at the same speed as the ordinary distributor for coil ignition, namely, half engine speed. Surrounding the rotating permanent magnet are stationary pole shoes which are produced to form the core of a coil unit. The latter carries the normal primary and secondary windings. The core actually surrounds the shaft, so that the windings come between the contact breaker and the permanent magnet, but are stationary. A condenser is connected across the actual windings. The contact breaker is a self-contained unit fitted above the windings, its cam having as many points as there are cylinders on the engine. The distributor is similar in all respects to that of a coil ignition unit, and the whole machine has been designed to fit into the mounting of such a unit as a replacement. The advantages of this magneto over conventional models are claimed to be that no delicate parts rotate, and that there is no gearing. An ingenious advance mechanism is incorporated consisting of packs of specially shaped centrifugal weights to which the magneto shaft is coupled. They are coupled to the pinion by means of a central, irregularly shaped boss. As they move outwards under centrifugal force, the shape of the boss causes them to move round its circumference, at the same time providing sufficient frictional resistance to obviate the use of retaining springs. Thus no disturbance of the setting of the advance need be feared, owing to heat, fatigue, or other causes likely to affect a spring mechanism.

An interesting attachment for use on motor cars or lorries is illustrated in Fig. 29. It is the Bendix power brake mechanism. As will be seen, this device is very simple and forms a useful aid to those whose brake operation in a day amounts to a respectable amount of work, as is the case of many under modern traffic conditions. The power used is the vacuum produced in the induction pipe, which is brought by flexible piping, first to the valve, and thence to the operating cylinder. The simplicity of this installation renders an explanation of its method of operation unnecessary. Another use of vacuum power exploited by Bendix, Ltd., is for clutch withdrawal. This system has been used successfully on Morris and Wolseley cars, and provides yet another simplification of the controls of the modern motor car. In use it performs all clutch operations automatically under the influence of the accelerator pedal. The principle of operation is very simple. The accelerator pedal is connected to the control valve and is permitted to over-travel its "engine idling" position. This over-travel opens the valve, creating a direct vacuum passage from the power cylinder to the engine intake manifold, causing the clutch to be disengaged. Since the clutch is not disengaged until after the accelerator pedal has passed its idle position, it is still possible to use the engine compression for braking purposes and to drive normally with clutch engaged and engine running at idling speed. The accelerator pedal must be relieved of all pressure before clutch-disengaging action will take place. As the accelerator pedal is depressed to speed up the engine, the valve is again closed, cutting off the vacuum connection, and the clutch returns to engagement through the force of the clutch springs as with foot usage of the clutch. The speed of the return travel of the clutch, however, is controlled; a rapid movement is allowed up to the point where the clutch starts to take up the load of the car. From this point until the moment of full engagement, the speed is slowed down—perfectly controlled—to effect a smooth engagement. The desirability of this velvety engaging action is always stressed by car makers, but seldom accomplished by the use of the unsteady human foot and leg. The system may be cut in or out of use quickly and easily at the will of the car driver, simply by pulling out a button accessibly located on the instrument board.

In addition to features of design which were novel, and as such interesting, there were many exhibits which retained a more conservative aspect, but which were, nevertheless, of technical interest. The Vauxhall concern was showing a stripped chassis sectioned to show the construction. The A.C. cars remain basically as in 1935. They provide an excellent example of the design of a modern six-cylinder car. Among makes of car which show few changes from last year's models may be mentioned Standards, Citroën, Adler, Triumph, Morris, Austin, and M.G. Many of the American cars, such as the Packard, Studebaker, Cadillac V 8, Buick, Dodge, and Oldsmobile, have undergone very minor alterations of chassis design, but bodywork has been redesigned in many cases, according to the dictates of the present fashion for so-called streamlining.

Turning back to the Garage Section, certain other makers not so far mentioned had exhibits worthy of short description. Wellworthy, Ltd., Lymington, Hants, exhibited various models of piston rings of the "Superslot" and "Wellworthy-Simplex" types, together with the "Welflex" compensating piston. A range of compressed air fittings, jacks, both hydraulic and mechanical, and garage machines was shown by B.E.N. Patents, Ltd., of Park Royal, N.W.10. They included paint spray plant, car-washing machines, and tire-inflation compressor units. Trico-Folberth, Ltd., of Brentford, showed a neat fan for car interior ventilation. It is operated by vacuum from the engine. A neat supercharger was on view at the stand of Centric Superchargers, Ltd., of Preston. A demonstration of great interest of oxy-acetylene welding and of apparatus for welding purposes was given by the British Oxygen Company, Ltd. Equipment suitable for dissolved acetylene, which to-day has numerous uses, was included among the exhibits. Germ Lubricants gave a demonstration of the "oiliness" comparator described in THE ENGINEER of April 26th, 1929. Various fittings of the pressed type and small turnings were shown by Ross, Courtney and Co., Ltd., of Upper Holloway, N.19. T. B. Andre and Co., Ltd., of Victoria-gardens, W.11, provided a selection of a range of automobile accessories for inspection. Delco-Remy and Hyatt, Ltd., exhibited ignition systems, including the new vacuum load control and magnetic timing control, which enables the ignition to be regulated not merely by the speed of the engine, but also by the vacuum in the induction pipe, which is equivalent to the degree of throttle opening. Various portable electric tools were exhibited by Desoutter Brothers, Ltd., of Hendon. The Lucas, Rotax, and C.A.V. exhibits provided a comprehensive show of practically every electric fitting used on the motor car to-day. Particularly interesting was some of the testing apparatus. In general, the garage equipment section of the Motor Show provided a wonderful opportunity for the engineer to see the extent to which automatic tools and specialised equipment have been developed to meet the needs of one of the most important industries in the British Isles.

The four and six-cylinder marine oil engines exhibited on the stand of the Associated Equipment Com-

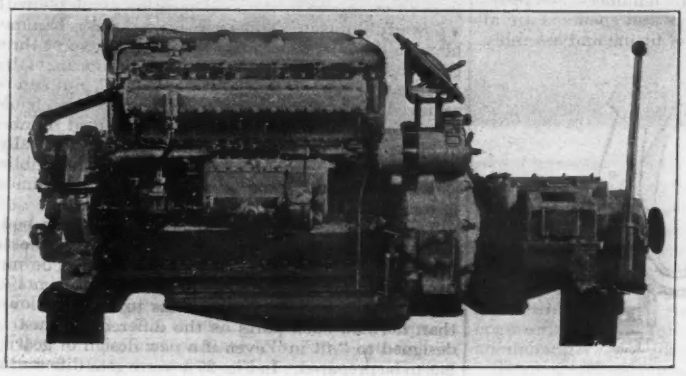


FIG. 30—SIX-CYLINDER 100 B.H.P. MARINE OIL ENGINE—A.E.C.

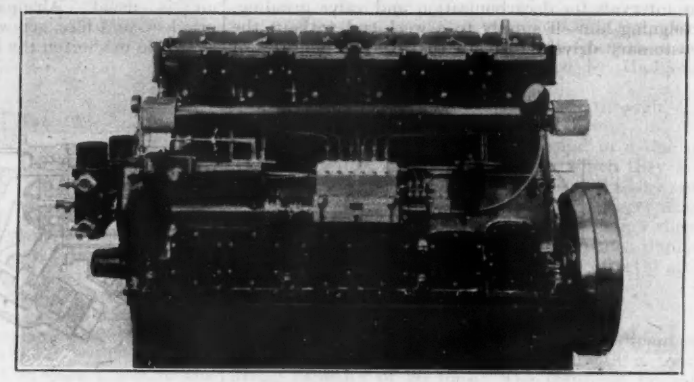


FIG. 31—SIX-CYLINDER 220 B.H.P. M.A.N. OIL ENGINE—SPICER

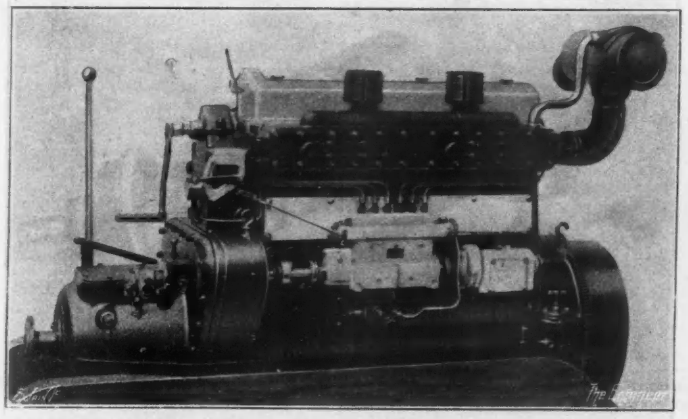


FIG. 32—SIX-CYLINDER 54/70 B.H.P. MARINE OIL ENGINE—THORNYCROFT

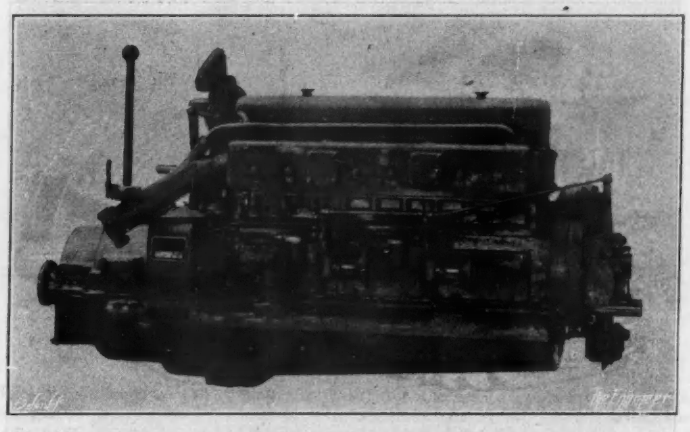


FIG. 33—SIX-CYLINDER 35/70 B.H.P. MARINE PETROL ENGINE—PARSONS

pany, Ltd., of Southall, Middlesex, were of unusual interest on account of the care which has been taken to fit these standardised engines for long and continuous marine service. They are constructed in accordance with Lloyd's Survey requirements, and operate on the four-stroke principle with airless injection into an A.E.C.-Ricardo combustion chamber. The four-cylinder engine has a bore of 108 mm. with a stroke of 146 mm., giving a swept volume of 5·35 litres and a maximum continuous output rating of 47 b.h.p. at 1250 r.p.m., the compression ratio being 16·5 to 1.

In Fig. 30 we illustrate the six-cylinder unit, which has a designed output of 100 b.h.p. at 1500 r.p.m., or 125 b.h.p. at 2000 r.p.m. for special craft. This engine has a bore of 115 mm. and a stroke of 142 mm., with a swept volume of 8·85 litres. Our engraving clearly shows the neat arrangement of the fuel pump

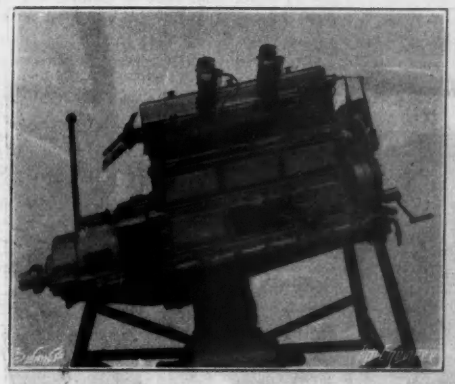


FIG. 34—100 B.H.P. MARINE ENGINE—PARSONS

and governor, with the through drive to the starting dynamo and pumps, together with the illuminated instrument board at the fly-wheel end of the engine. The clutch is of the standard Parsons type. The weight of the four-cylinder unit with fly-wheel, but without the reverse gear is about 1840 lb., while that of the six-cylinder unit under like conditions is about 2200 lb. This figure can, however, be reduced to 1870 lb. by using a silicon-aluminium alloy crank case.

A new M.A.N. engine was exhibited on the stand of George Spicer, of the Market-place, Brentford. This firm has been recently appointed concessionnaire in Great Britain for high-speed engines of this type up to 180 b.h.p. per unit. The six-cylinder engine, which is illustrated in Fig. 31 herewith, has a bore of 175 mm., and a stroke of 220 mm., with a designed output of 180 b.h.p. at 900 r.p.m.; at a higher speed of 1200 r.p.m. the rated output is 220 b.h.p. The engine is complete with Bosch fuel pump and injectors, and the reverse gear and electric starting, and if desired a reducing gear of 2 : 1 or 3 : 1 can be fitted. On the stand there was exhibited a wide range of Thornycroft engines and marine auxiliary equipment.

A noteworthy exhibit on the stand of the Parsons Oil Engine Company, Ltd., of Town Quay Works, Southampton, was a twin-screw petrol marine set, with reduction gear, so built up that although the engines operate in the same direction and all parts are therefore interchangeable, the propellers rotate in opposite directions because one reducing gear has a helical drive and the other a triple chain drive. Each engine can be adapted for either petrol or kerosene fuel. As a petrol engine it has a designed output of 10 to 20 b.h.p. at 1000 to 2000 r.p.m., with a bore of 2¾in. and a stroke of 4in. We illustrate in Fig. 33 a similar six-cylinder unit with a designed output of 35 to 70 b.h.p., at speeds of 1000 and 1800 r.p.m., with a bore of 3¾in. and a stroke of 5in. A feature of

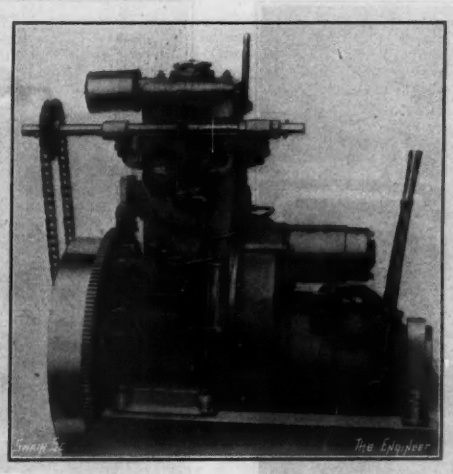


FIG. 36—SINGLE-CYLINDER 8/12 B.H.P. ENGINE —AILSA CRAIG

this engine is the cooling of the crank chamber by cold sea water. A further interesting Parsons engine is the six-cylinder 100 b.h.p. unit, which is frequently used for high-speed craft for special services. Fig. 34 shows the unit in the inclined position it occupies in the boat. Although it has an output of 100 b.h.p. at 2000 r.p.m., installations are in continuous operation in which speeds of 2300 to 2400 r.p.m. are maintained with an output of about 140 B.H.P. It has a bore of 4¼in., with a stroke of 5in., and is built for petrol fuel only.

The space at our disposal will not allow us to deal fully with the whole of the exhibits in the marine and motor boat section ; the exhibits of one or two other

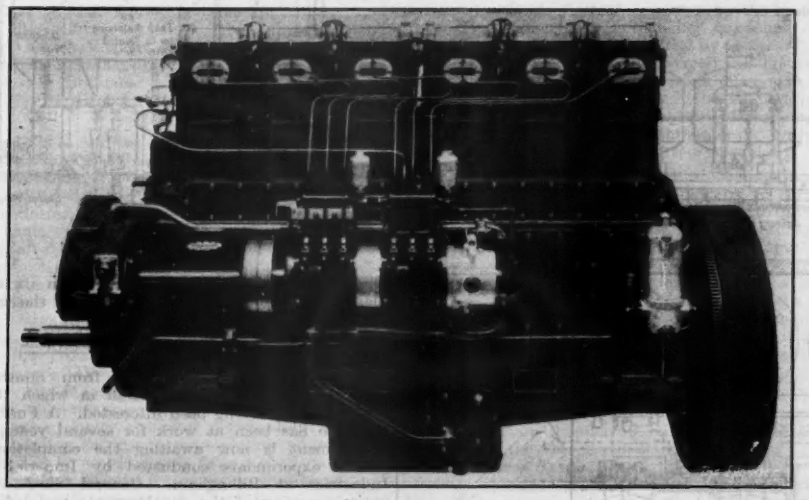


FIG. 35—102 B.H.P. MARINE ENGINE—NORRIS, HENTY

usual lubricating oil and circulating water and bilge pumps, which are neatly arranged at the end of the engine opposite to the fly-wheel. Large inspection doors are provided and light metal alloy is freely used for inspection doors and cylinder head covers, &c. The engine embodies the M.A.N. patented ante-chamber combustion system.

The outstanding exhibit on the stand of John I. Thornycroft and Co., Ltd., of Smith-square, London, was a 38ft. twin-screw motor cruiser, designed for seagoing work, and provided with two four-cylinder Thornycroft petrol engines, having a designed output of 10 to 17 b.h.p. each. We have, however, chosen for illustration the six-cylinder R J 6 oil engine, shown in Fig. 32. It has a designed output of 54 to 70 b.h.p. at 1200 to 1600 r.p.m., and the engine embodies the firm's latest marine practice, and operates on the airless injection principle, with a Bosch or similar injection system. It is equipped with Thornycroft firms call, however, for short mention. On the stand of Ailsa Craig, Ltd., of Strand-on-the-Green, Chiswick, there was shown a wide range of marine motors. We illustrate in Fig. 36 herewith the single-cylinder, 8 to 12 b.h.p. marine engine complete with reverse gear. It is one of a range of engines made in single up to eight-cylinder units for power from 8 to 12 up to 64 to 96 b.h.p. The engine illustrated in Fig. 36 embodies the firm's standard marine practice, and is generally similar to the engine referred to in our issue of October 11th. The Brooke Marine Construction Company, Ltd., of Lowestoft, showed a full range of marine and industrial petrol and paraffin engines for 2 to 100 b.h.p., and also standard vee type drives. A special exhibit was the twin-cylinder, heavy-oil engine of the Brooke-Ricardo type, complete with reverse gear and electric starting. This engine has a bore of 4in. and a stroke of 4½in., and is built in two and four-cylinder sizes with designed outputs of 12 to 16 and 24 to 35 b.h.p.

On the stand of Norris, Henty and Gardner, Ltd., of London and Patricroft, there was exhibited a series of marine oil engines complete with reverse and reduction gears. One of the new models is the L 3 type high-speed marine engine, with six cylinders, shown in Fig. 35. It has a designed output of 102 b.h.p. at 800 r.p.m. for continuous service, with an output of 153 b.h.p. at 1200 r.p.m. for intermittent duty. A feature of the engine is its ability to be started from cold by hand, although an electric starter or air starting can be fitted. The hand-starting arrangement consists of a raised shaft at the level of the cylinder heads, which is connected by a chain drive to the crankshaft through a patented form of free wheel. At either end of the raised shaft are cone connections for the starting handles. For air starting a connection is made from three cylinders, whereby compressed air can be obtained for charging the starting air receiver when the fuel pump units for these cylinders have been cut out. The engine illustrated is constructed in units from three to eight cylinders in powers of 17 b.h.p. per cylinder while a smaller series of L 2 units have 9½ b.h.p. per cylinder. The engines work on the airless injection principle, and a low fuel consumption of the order of 0·39 lb. per b.h.p. hour is guaranteed.

BRIDGE BETWEEN DENMARK AND SWEDEN.

A SCHEME has been advanced in Denmark for the construction of a bridge between Denmark and Sweden by the establishment of a connection over the Oresund (Sound) of a total length of 13 kiloms. The project has been prepared by bridge engineers, and a company has been formed to promote the plan by the firms of Monberg and Thorsen, Hojgaard and Schultz and Christiani and Nielsen. Saxild and Co. are also associated with the scheme, together with German interests.

According to the proposal, a combined bank and bridge connection would be constructed from Amager *vid* Saltholm to Limhamn. Large parts of the connection would be formed of banks, while the bridge would be constructed only over the two navigable channels of Drogden and Flint. In the Drogden Channel, the piers would be anchored at a depth of 10 m. The depth in the Flint channel amounts to between 20 m. and 24 m., but the navigable channel is barely a mile in width. By way of comparison it may be mentioned that the piers in the Little Belt stand at a depth of up to 35 m. The length of the entire bridge is calculated at 3·1 miles. In order to ensure the execution of the scheme, it is assumed that co-operation would be obtained from Sweden, and it is stated that Swedish engineers have already also worked on the scheme, and that plans have been prepared for railway and road connections on each side. Should the project be carried out the journey over the Oresund would be effected in twenty minutes as compared with the one and a half hours now occupied by transport by steam ferry.

Almost simultaneously it has been announced that a Swedish proposal for the construction of a bridge over the Oresund has also been worked out. This scheme aims at the building of a high level bridge in the narrowest part at Halsingborg, and an alternative at Malmo has likewise been prepared and is well advanced. The Swedish project has been devised by the civil engineers, Messrs. Evers and Norder under the supervision of Professor Linton, of Gothenburg, while the Malmo alternative is being advocated by others. The Halsingborg bridge would be established at Palsjo, directly to the north of Halsingborg, on the Swedish side, and on Danish territory it would be directly to the north of Marienlyst. The bridge would be of steel construction, and would be designed to leave a navigable width of 42 m. Professor Linton maintains that it is essential to establish a rapid connection over the Oresund if Sweden is not to lose an appreciable part of the West Coast traffic. Inquiries made in Swedish State Railway circles have resulted in the statement that it is considered that the bridge-building problem is not one of actuality at present. It is pointed out that the connection between Malmo and Copenhagen is already good, and that the air services, with numerous flights daily over the Sound, are sufficient to satisfy the requirements of rapid travel.

BRITISH STANDARDS INSTITUTION.

All British Standard Specifications can be obtained from the Publications Department of the Institution at 28, Victoria-street, London, S.W.1. The price of each specification is 2s. 2d. post free, unless otherwise stated.

FORTHCOMING SPECIFICATIONS.

Methods for the Sampling and Analysis of Coal and Coke.—In accordance with the usual procedure, the Coal and Coke Technical Committee of the Chemical Division has circulated to interested organisations and to the trade draft British Standard methods for the sampling and analysis of coal and coke for short period tests on industrial plant and other appliances. The specified methods are a development of the standards which have been previously issued by the Institution for the commercial buying and selling of coal and coke, and are based on the results of research which has been carried out by members of the Committee. The draft Specification will be reviewed in five or six months' time, in the light of the criticisms received, and further modifications may then be made prior to its adoption and issue as a British Standard. Copies of the draft specification (C D 7224) may be obtained from the Institution's Publications Department, price 2s. 2d. post free.

Water Purification Plant at a Woollen Mill.

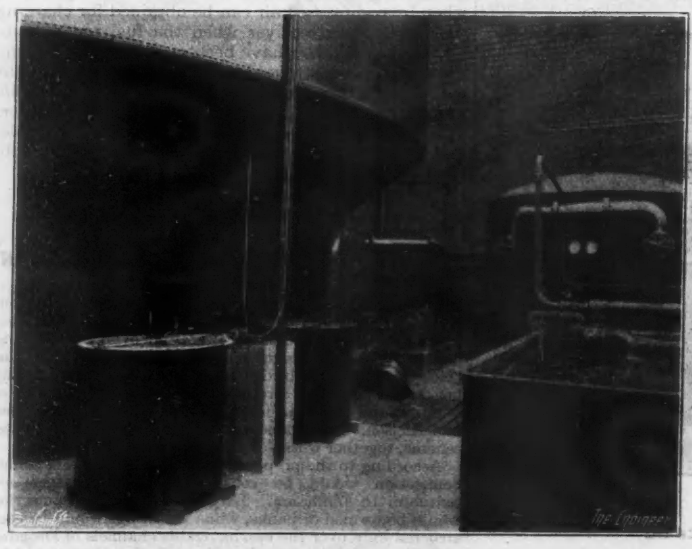
IT has been found in many instances to be advantageous to substitute for an original pure supply of water a cheap impure supply which can be purified inexpensively. The purification plant illustrated herewith is an example of such substitution. It provides for the treatment of a heavily contaminated and turbid river water supply, and is claimed to have yielded a great economy on the previous use of the water supplied by the public waterworks. The plant was supplied by William Boby and Co., Ltd., of London, to Henry Hamer and Sons, Ltd., for their Ravens Ing Woollen Mills, near Dewsbury, Yorks. The mill is situated on the bank of the river Calder, the water of which is contaminated by trades wastes to an extent rendering it totally unfit in its raw condition for use for any purpose in the mills.

The plant has a capacity of 600,000 gallons per day, and carries out the purification in three distinct operations. The first operation consists of a chemical treatment for eliminating colour, together with organic matter in suspension and solution. The chemical reagents administered to the raw water coagulate and flocculate the impurities which are settled and thickened in a tank. Periodically, the sludge is evacuated from the tank. The overflow from the settlement tank is delivered into another tank of smaller size, whence it is passed by a pump into a battery of clarifying filters. From these quartz sand pressure mechanical filters the water is evacuated clear and freed from suspended matter in readiness for the third operation. The clarified water delivered from the filters is distributed to a battery of Boby "Azed" base exchange softeners, which complete the treatment. The water leaving the softeners is delivered into the soft water storage reservoir ready for use.

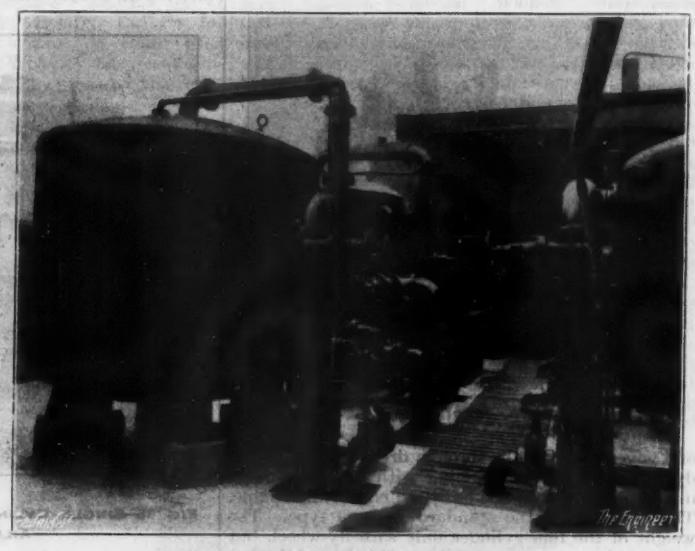
The accompanying line engraving illustrates the general arrangement of the plant in elevation, plan, and section. At the left-hand end of the elevation, the sedimentation and thickening plant is shown. An inlet pipe for the raw water discharges into a flume, mounted on top of the tank, and designed to form a hydraulic jump. The hydraulic jump is stated to possess very efficient mixing properties, and has the advantage of consuming less head than any other form of non-mechanical mixing device. At a short distance from the raw water inlet, the chemical reagents, which consist of sodium carbonate and alumina sulphate, are injected as solutions into the flume, where they are thoroughly mixed with the raw water. The dosed water flows from the hydraulic jump to a flocculating tube placed centrally in the tank. The water emerges from the bottom of the tube and rises slowly up the sedimentation and thickening tank to the bottom of which the flocculated impurities fall for evacuation by means of a system of pipes. There are two main sludge pipes, the outlet of each being provided with a sludge evacuation valve. When the water has ascended the sedimentation and thickening tank, it is decanted by four launders, and is delivered into a belt tank which supplies the treated water to an electrically driven centrifugal pump. This pump delivers the treated water into a battery of three 9ft. diameter quartz sand pressure filters. The water clarified by the filters then passes under the pressure generated by the pump to the two "Azed" base exchange water softeners, and thence to the storage tank.

Vessels are provided, as shown, for preparing the solutions of sodium carbonate and alumina sulphate. Electrically driven pumps fixed upon a concrete base between the vessels and level with their tops pump the reagent solutions, through piping, into the flume. The sedimentation tank, one of the pressure filters, and the brine tank are shown in our first half-tone engraving. Each filter is provided with two "loss of head" pressure gauges. The filters are self-washing. By suitably setting the valves, the water is passed through two filters and thence to the underside and upward through the third unit, which it cleanses. The "Boby" all-water high-velocity wash is employed. No preliminary air scour or mechanical rakes are required with this system.

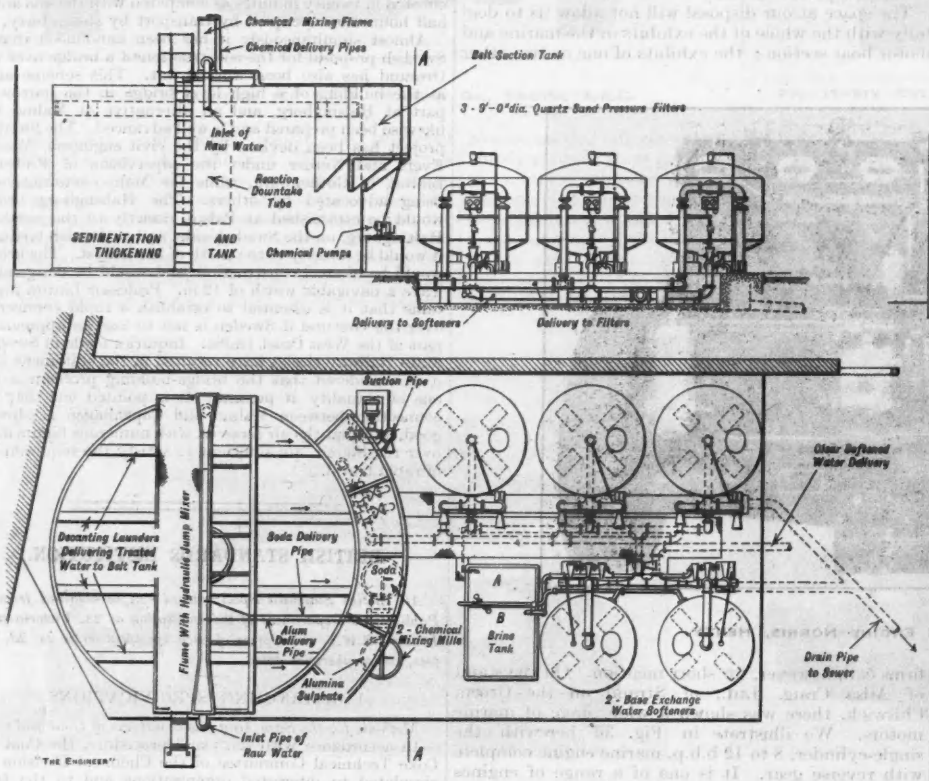
The two "Azed" softeners are shown in our second half-tone engraving. The softening beds consist of "Boby" rapid-action and stabilised mineral, by which the consumption of salt is reduced to a low figure. The rate of softening can be varied to suit the demand for water, and regeneration is rapidly effected. The brine tank is divided into two compartments. The brine partially spent by the action of regeneration is delivered into one of the compartments A, while fresh brine is prepared in the other compartment B. When regenerating is being carried out, the partially spent brine is first passed through the bed, and is followed by the fresh brine, which displaces the charge of partially spent brine, and discharges it to the drain. The fresh brine, after passing through the bed, where it becomes partially spent, is, in its turn, discharged into the first compartment A of the tank to be employed in the next regeneration.



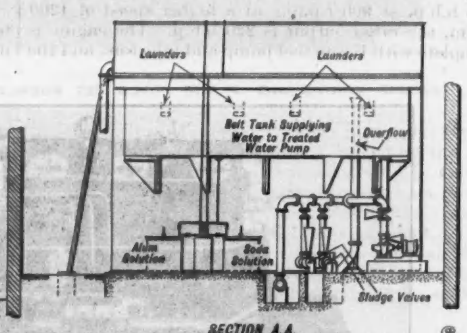
SEDIMENTATION TANK, PRESSURE FILTER AND BRINE TANK



BASE-EXCHANGE WATER SOFTENERS



GENERAL ARRANGEMENT OF WATER PURIFICATION PLANT



SECTION A.A.

THE extraction of crude oil from South African minerals is a branch of research in which the Union Government has long been interested. A Fuel Research Institute has been at work for several years, and the Government is now awaiting the completion of the British experiments conducted by Imperial Chemical Industries at Billingham. General Smuts takes an optimistic view of the developments and believes that important oil industries may arise in South Africa shortly. Costs of production, General Smuts points out, are still comparatively high, but technique and machinery are steadily being perfected. The discovery of valuable petroleum fields in the Union seems remote, though much prospecting has been done. The well-known torbanite deposits in the Transvaal have, however, recently been mined by a company, very inexpensively, while the retorting and refining is being carried on at factories newly erected and the costs are not expected to be high. Many experts hold the view that the utilisation of the Union's coal reserves, estimated at 250,000 million tons, should receive the first consideration. Some authorities have declared that, outside Germany, South Africa is one of the most favourable countries for the erection of a plant. It is confidently expected by the Government and its experts that the exploitation of the oil-bearing shales of the Transvaal is the beginning of the development of the oil resources of the Union, and that with the enormous reserves of coal available in the Union it should ultimately be possible to produce oil products very much below the prices of imported products. At present the Union is entirely dependent upon imports from overseas and mainly from the United States.

Rail and Road.

A CONSIDERABLE proportion of the interests of Suttons—the old-established firm of carriers—has been purchased by Carter, Paterson and Co. The latter business is now controlled by the railway companies, and the new boards of Sutton and Co., Ltd., and Sutton and Co. (Manchester), Ltd., will include representatives of Carter, Paterson and Co. and of the railway companies.

THE *London and North-Eastern Railway Magazine* for October gives that company's financial results for the first half of the present year. Whilst the freight traffic figures are very disappointing, especially the fall of 2·1 per cent. in the tonnage of coal and of 3·1 per cent. in the receipts from coal, the number of passenger journeys shows the gratifying increase of 3·0 per cent. and the passenger receipts 2·4 per cent. The point of special interest is that since the first-class fares were reduced on January 1st last, the number of first-class journeys has increased by 7·9 per cent. and the first-class receipts by 3·8 per cent.

IT is announced that the L.M.S. Railway has placed orders with British manufacturers for nearly 900 new road vehicles. These orders have been made with the two-fold object of improving the company's existing fleet of road vehicles, and making provision for increasing traffic requirements. Among the various types of vehicles ordered are works trucks, parcels vans, tipping lorries, mechanical horse tractors and trailers, and light and heavy goods lorries. The orders have been placed with fifteen different firms. In addition, seventy-eight mechanical horse trailers are to be made at the company's Wolverton works.

IN recording herein on October 11th the results of the thirty-nine weeks' traffic of the main line companies, we showed that the London and North-Eastern had to record a decrease on the year. Thanks, however, to a greater coal traffic there is a change for the better on that line, and bigger increases are being recorded by the three other companies. At the end of the forty-second week the total traffic receipts, when compared with the corresponding period of 1934, showed increases as follows:—L.M.S., £572,000, or 1·18 per cent.; L.N.E., £4000, or 0·01 per cent.; G.W., £121,000, or 0·59 per cent.; and Southern, £154,000, or 0·93 per cent.

THE first meeting of the representatives of the companies and of the men to consider the application of the latter to complete the restoration of the "cuts" in their wages took place on Tuesday, October 22nd. The official statement subsequently issued was to the following effect:—"Representatives of the four grouped railway companies met representatives of the National Union of Railwaymen, the Associated Society of Locomotive Engineers and Firemen, and the Railway Clerks' Association for the purpose of hearing applications made by the trade unions for the discontinuance of the percentage deductions from earnings operating under the agreement of August 10th, 1934, and variations of certain conditions of service as determined by the National Wages Board decision of March 5th, 1931. The trade union representatives explained the ground of their claims, and the railway companies' representatives undertook to examine the position. A further meeting will be held on November 26th."

ON page 85 of our issue of July 27th, 1934, we recorded that on the initiative of Mr. John Miller, Engineer, North-Eastern Area, London and North-Eastern Railway, tablets were being placed on some of the more important railway bridges on that system in order to increase the interest of the passing traveller. The proposal then covered the Victoria Viaduct over the Wear, the Royal Border Bridge at Berwick, and the King Edward Bridge at Newcastle. On September 8th last a similar commemorative tablet on the High Level Bridge at Newcastle was unveiled.

IN his Presidential Address at the Institute of Transport on October 14th Sir Cyril Hurcomb said that the whole of the competitive traffic of the four grouped companies was now pooled, and it had been estimated that out of gross receipts amounting to £150,000,000, not less than £70,000,000 came within the scope of pooling agreements. Additionally, all the suburban passenger receipts between main line stations, numbering 650, in the London transport area, were pooled with the receipts of the London Passenger Transport Board from its railways, tubes, trams, trolley vehicles, and omnibuses. The receipts of the main lines paid into this pool were estimated to amount approximately to £10,000,000. Sir Cyril, in recording that the pooling schemes of the grouped companies had to be approved by the Minister of Transport, who usually referred the question to a committee, said that in the course of the consequent inquiry the great organisations representative of industry and commerce withdrew all opposition, and asked to be reported as in favour of the pooling scheme. That was a striking testimony to the change in the attitude of traders towards railway companies.

THE death on October 23rd, of Sir John Pybus calls for mention in this column because it was whilst he was the Minister of Transport from 1931 to 1933 that the difficult question of London traffic was at long last settled by the London Passenger Transport Act. That question was a problem nearly one hundred years ago, as in 1842 there was a Royal Commission appointed to inquire as to the most effectual means of providing increased facilities of communication within the Metropolis. The most thorough inquiry into this important matter was that conducted by the Royal Commission appointed on February 10th, 1903, which reported on June 26th, 1905. It cannot be said that anything of a tangible character resulted from the labours of that body, and it was not until the conclusion of the war brought congestion on the railways, and the increase of motor vehicles filled the streets, that anything was done to find relief. The Ministry of Transport then set up Traffic Advisory Committees, but it was left to Mr. Herbert Morrison to produce a scheme. When we remark that this provided him with a text for his book "Socialisation and Transport," it will be appreciated that the scheme was not generally acceptable, but it furnished the basis for Sir John Pybus' more successful efforts.

Miscellanea.

IT is estimated that over £10,000,000 worth of orders were placed during the nine days of the Motor Car Show at Olympia.

WE are informed that Mr. G. T. Cotterell has accepted nomination as President of the Institution of Sanitary Engineers for 1936.

SPEAKING at a recent luncheon the Minister of Mines said that since 1928 the average cost of production per ton of coal had decreased by 1s. 3d.

A TELEPHONE service between Great Britain and Ceylon has been inaugurated. The service is by radio telephone to India and thence by land line and cable to Ceylon.

A CONTRACT for the construction of the dam for the proposed Lady Bower reservoir at Derwent has been placed. The value of the contract is about £700,000, and work is to be begun at once.

AT a meeting of the Council of the British Engineers' Association following the twenty-third annual ordinary general meeting, held on October 10th, Mr. William Reavell was unanimously re-elected President of the Association for the ensuing year.

THE opening function of the South Australian Centenary Celebrations will be an Empire exhibition held at Adelaide from March 20th to May 16th, 1936. Owing to the large number of applications for space, it is expected that it will be necessary to erect further buildings.

A PAPER presented before the Canadian Chemical Convention during the summer gave a number of uses of acetylene black as an heat insulator. As this material is practically pure carbon, it does not contain harmful or corroding impurities, it does not easily absorb water, and time has but little deteriorating effect.

UNDER the Order in Council dated February 6th, 1928, the Lord President of the Council has appointed Dr. W. H. Mills, Lord Riverdale, Professor A. Robertson, and Mr. H. B. Shackleton to be members of the Advisory Council to the Committee of the Privy Council for Scientific and Industrial Research. Dr. E. J. Butler, Sir Kenneth Lee, and Professor N. V. Sidgwick have retired from the Council on the completion of their terms of office.

AT the ordinary meeting of the Institution of Electrical Engineers to be held on November 7th, Lieut.-Colonel K. Edgcumbe, past-President, will on behalf of Colonel R. E. Crompton present to the Institution an oil painting of Colonel Crompton by Mr. George Harcourt, R.A. The painting was subscribed for and presented to Colonel Crompton by a group of "Old Cromptonians," and other admirers on the occasion of his ninetieth birthday, but at his express desire it is now to become the property of the Institution.

ACCORDING to a recently issued report of the International Tin Research and Development Council, during 1933 there were some 18,000 tons of tin solders prepared, the largest consumers being the tin box manufacturers and motor car trades. The bulletin gives a large amount of useful and detailed information on the compositions and physical properties of the solders used in various industries, a particularly useful feature being an account of the ordinary forms of commercially prepared solders and the uses for which they are best suited.

A PROCESSED lime for making water-repellant mortar that is being marketed in the United States, described in the *Chemical Trade Journal*, is stated by the makers to consist of a high-calcium hot-slaking quicklime in pulverised form, to which has been added by process of atomisation and mechanical mixing a relatively small percentage of fat or oil of vegetable or animal origin. It is stated that a dry-prepared mixture of either hydrated lime or pulverised quicklime, together with calcium stearate or similar metallic soap, has been found unreliable as a practical commercial project for waterproof mortar-making.

THE Moscow correspondent of the *Manchester Guardian* reports that the plans for the second section of Moscow's underground will be considerably modified to introduce features of the London Underground Railway system. The assistant chief engineer praises the durable and economical architecture of the London Underground, its safety, and its planning, criticising only the lack of bright and luminous colours in the stations. As a result of the observations in London, the tunnels under construction in Moscow will be narrowed from 19½ft. to 13¾ft. Escalators on the London plan will be built.

A LARGE extension to the buildings used for the Engineering and Hardware Section of the British Industries Fair at Castle Bromwich, Birmingham, has been approved by the Birmingham Chamber of Commerce, which organises this section of the Fair in collaboration with the Department of Overseas Trade. So far the Management Committee has received applications for 291,000 square feet indoors at next year's Fair, and only 265,000 square feet are actually available at the moment. The extension is to consist of a new building 720ft. long by 72ft. wide, and will be added to the north side of the existing building, that part which is devoted to the electrical and engineering group. The addition will give 31,000 square feet more space than was available at the 1935 Fair, making a total of 296,000 square feet for exhibits indoors in 1936.

THE Port of London Authority has decided to provide additional under-cover storage accommodation for timber at the Surrey Commercial Docks. The erection of three new sheds, providing a covered area of 219,180 square feet, with a storage capacity of 20,000 tons, is to be put in hand immediately. The site for the sheds is at the north-west corner of the Lavender Dock, Surrey Commercial Docks system, and a canal is to be constructed between the sheds to enable a number of barges to be unloaded simultaneously. A new roadway, with cartways for loading facilities, is also to be provided. The estimated cost of the works proposed is £71,500. When these new sheds are complete, under-cover storage accommodation at the Surrey Commercial Docks will be available for 271,000 tons of timber, and the total storage capacity under cover and in the open will be for 500,000 tons.

Air and Water.

DURING September there were eight steam and motor vessels of over 500 tons gross register totally lost; of these five of 11,414 tons were British.

THE special correspondent of the *Daily Telegraph* on board the salvage vessel s.s. "Orphir," reports that the wreck of the "Lusitania" has been located at a depth of some 300ft.

THE University of Cambridge has accepted a gift of £10,000 from Sir John Siddeley for the purpose of helping in the development of aeronautical research in the University.

IT is reported that proposals have been made by Pan-American Airways to the Government of New Zealand for the opening of an air route between San Francisco and Auckland next year.

IT is reported that the Dornier Company has completed the construction of a new flying boat propelled by two 560 h.p. heavy-oil engines. The machine is said to have a range of 2485 miles, with a cruising speed of 124 miles an hour.

A NEW five-seater aeroplane, the Heston "Phœnix," is described in *Flight*. This machine is a high-wing, strut-braced monoplane, with a retractable undercarriage, and is constructed almost entirely of wood. Propelled by an inverted 200 h.p., six-cylinder De Havilland Gipsy Six engine, the machine has a range of 500 miles with a full load at a cruising speed of 120 miles an hour.

THE development which has taken place in aircraft wireless business has made it necessary for the Marconi Company to create a new organisation, known as the Marconi Aircraft Wireless Establishment, in which will be centred all activities concerning the development, design, and manufacture of all kinds of aircraft wireless apparatus. This establishment has recently been opened at premises in Wandle-road, Hackbridge, Surrey.

ACCORDING to the recent list of registered civil aircraft issued by the Air Ministry, there are 518 machines registered under regular air transport companies and 7110 registered civil aircraft in the United States. Germany comes next with 239 machines registered under regular air transport companies and 1741 registered civil aircraft. Third and fourth positions are taken by France and Great Britain with 211 and 165 machines respectively registered under transport companies, and 2093 and 1445 registered civil aircraft.

THE Air Ministry has ordered 174 Avro "Anson" high-speed, twin-engined monoplanes for reconnaissance squadrons. This machine is a development of the Avro 625 commercial monoplane, and is the first development of commercial design to go into R.A.F. service. Structurally it resembles its civil counterpart. The new machines have Cheetah IX engines, rated at 310 h.p. at 6000ft., with a maximum power of 339 h.p. at 6800ft. The machines have a maximum speed of 188 miles an hour and a cruising speed of 160 miles an hour.

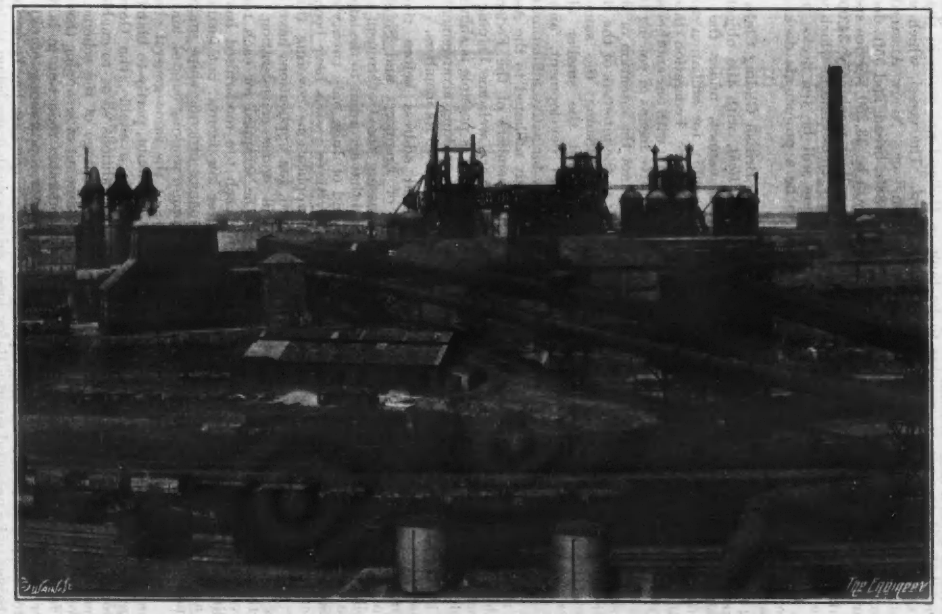
PARTICULARS of the new Holland-America liner which is to be built in Holland are given in the *Shipbuilding and Shipping Record*. The vessel, which will be named either "Prinsendam" or "Nieuw Amsterdam," will be 751ft. long overall, 88ft. broad, and 55ft. deep to B deck; the gross tonnage will be 33,250, service speed 20½ to 21 knots, and the propelling machinery 34,000 s.h.p. She will have two funnels, the second of which will serve as a ventilator, and there will be ten decks, in addition to which there are to be a promenade deck, a boat deck, and a sun deck.

THE Federation of British Gliding Clubs has recently been formed, says *Flight*, with the object of assisting gliding clubs which cannot, under the 25-minimum-membership rule, qualify for affiliation to the British Gliding Association. The Federation intends to help such clubs to keep in touch with one another and to provide for them an authoritative means of voicing their interests. It is stated that it is not the intention of the Federation to operate contrary to the interests of the British Gliding Association, but, by pursuing the same objects as the Association, to assist the smaller clubs towards increased activity and development, and, eventually, enable them to qualify for active affiliation to the B.G.A. Clubs which are already affiliated to the Association and which also become members of the Federation will, it is felt, be lending a very welcome helping hand to the weaker clubs. That this is possible is shown by the fact that the Federation is making arrangements for soaring sites to become available to its members.

IN his presidential address before the North-East Coast Institution of Engineers and Shipbuilders, Mr. J. T. Batey, discussing the Government's "scrap and build" scheme, said that according to the latest particulars published at the end of July, only twenty-eight applications covering forty-three vessels have been made under the scheme, ten applications covering thirteen vessels have been approved, ten applications have been rejected and eight are still under consideration. Restrictions that 2 tons must be scrapped for each ton built, or 1 ton scrapped for each ton modernised have, no doubt, contributed to these low figures, but further conditions, such as that companies ordering ships under the scheme must have a minimum working capital, and that tonnage scrapped must be of the same general character as its replacements, are, no doubt, partly to blame. No doubt, as more experience is available, the Government will relax some of the conditions so as to enable shipowners to take a greater advantage of the scheme. Meanwhile, the unprecedented amount of scrapping that is proceeding has caused a considerable reduction in laid-up tonnage. With regard to the reconditioning of old vessels, it is reported that not a single case has been approved. Mr. Batey went on to say that according to latest statistics only 29 per cent. of this country's building berths are occupied in spite of the fact that 149 berths have been scrapped by the shipbuilders' activities in the endeavour to rationalise their industry. The number of insured men in the shipbuilding industry has fallen from 204,500 in 1929 to about 150,000 in 1935, while the number of men unemployed is about 67,000.

IRON AND STEEL WORKS OF STEWARTS AND LLOYDS, LTD. AT CORBY, NORTHAMPTONSHIRE

(For description see page 449.)

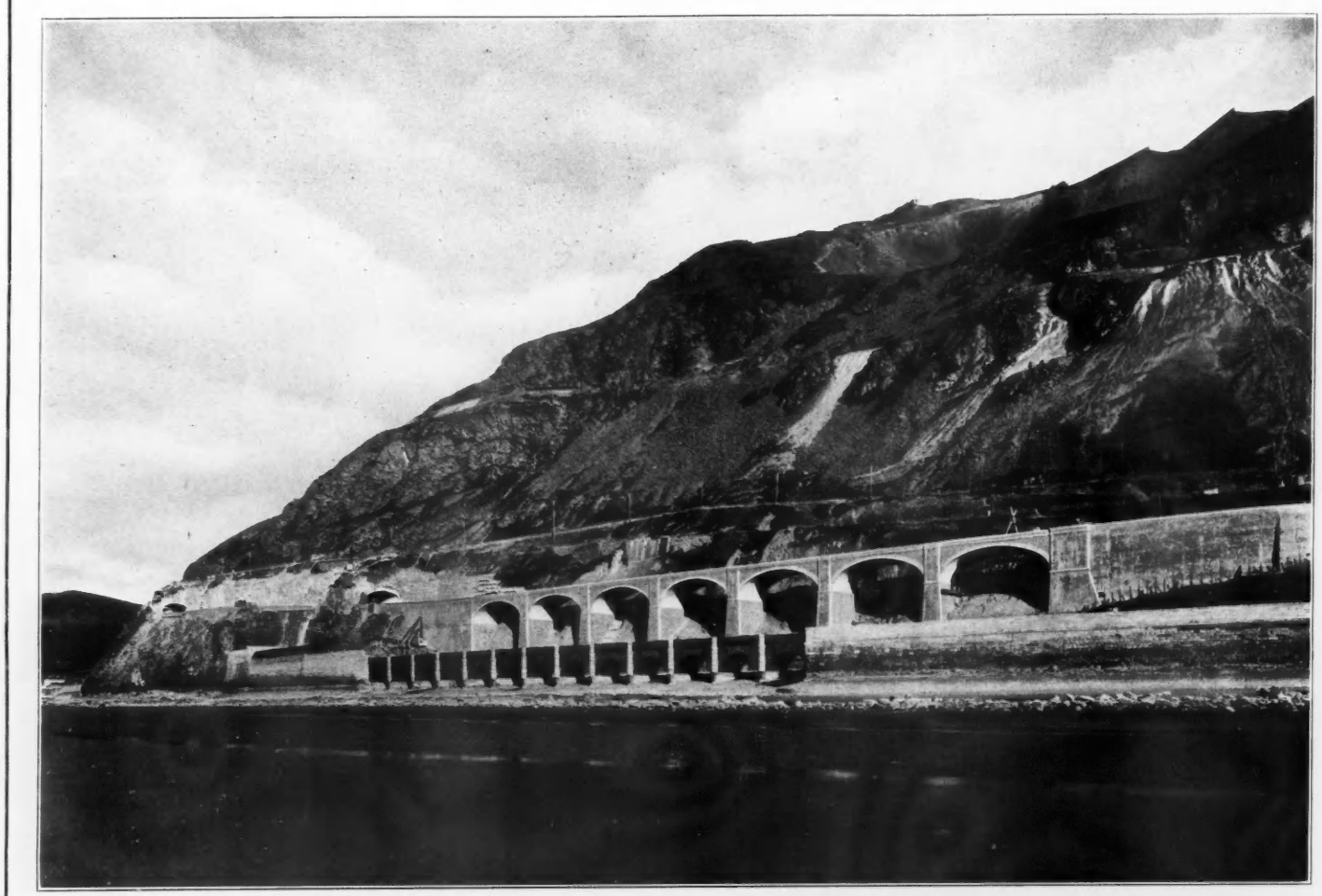


ABOVE—GENERAL VIEW OF BLAST FURNACE PLANT
BELOW—BY-PRODUCT PLANT AND GAS HOLDER

ABOVE—STEEL WORKS AND COKE-OVEN PLANT
BELOW—TUBE WORKS AND WAGON YARD

CONSTRUCTION OF THE CHESTER-HOLYHEAD

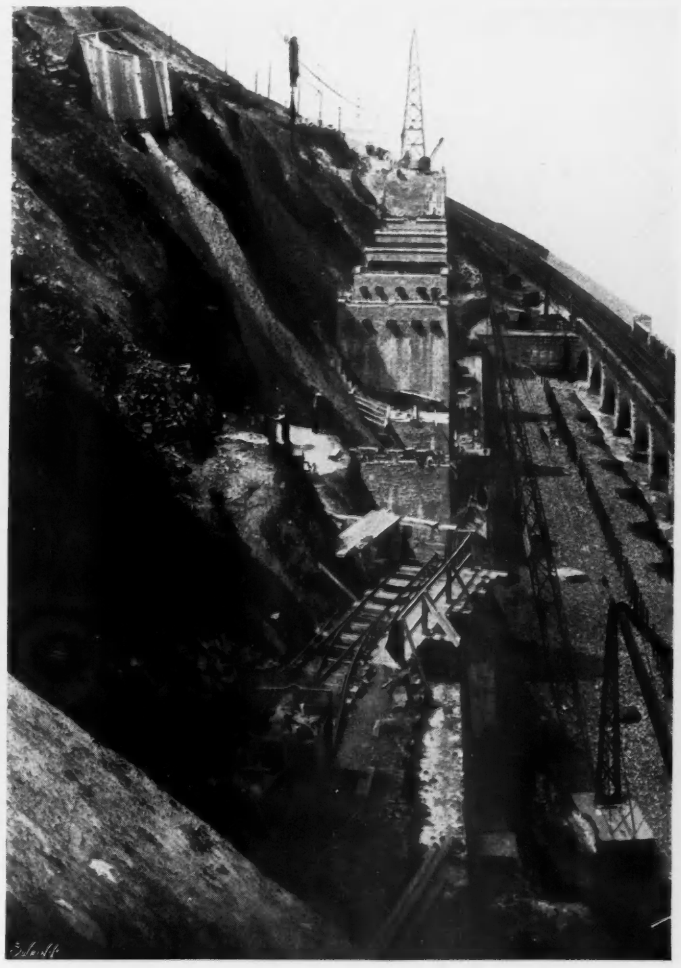
MESSRS. HOWARD HUMPHREYS AND SONS, WESTMINSTER, CONSULTING ENGINEERS



VIEWS SHOWING THE NEW AND OLD ROADS

HOLYHEAD ROAD AT PENYCLIP, NORTH WALES

AND WESTMINSTER, CONSULTING ENGINEERS



CONSTRUCTION OF ROADWAY TUNNEL, AND VIADUCT

The Engineer

NOVEMBER 1, 1935.

VOL. CLX. No. 4164

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NOTICES TO READERS.

**** If any Subscriber abroad should receive* THE ENGINEER *in an imperfect or mutilated condition, he will oblige by giving prompt information of the fact to the Publisher, with the name of the Agent through whom the paper is obtained. Such inconvenience, if suffered, can be remedied by obtaining the paper direct from this office.*

**** For Subscription rates, see page 2 of Advertisements.*

**** All letters intended for insertion in* THE ENGINEER *or containing questions should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

**** No undertaking can be given to return drawings or manuscripts; correspondents are therefore requested to keep copies.*

CHANGES OF ADDRESS.

**** Will subscribers please note that in all advices regarding changes of address it is necessary to have* **both the old and new addresses,** *as our lists are kept alphabetically by towns. Advices of this nature should reach us by the first post Wednesday morning prior to the alteration.*

THE SPIRIT OF ADVENTURE.

IN his Presidential Address to the Institution of Mechanical Engineers on Friday last, Colonel A. E. Davidson spoke, with sorrow, of the decline in the spirit of adventure in young engineers. Mr. Charles Day, proposing a vote of thanks to the President, mingled his regrets with the President's. Years ago, he said, if his firm wanted men to go abroad, there were many volunteers; now it was difficult to find one. That we understand is not the universal experience. Another employer told us that his firm, a very large one, had no difficulty whatever in finding recruits for foreign service; in fact, the volunteers exceeded the vacancies. Between these two views there is such sharp divergence that we are forced to the conclusion that special reasons, connected possibly with the trades or the geographical areas, must exist to account for it. In any case they cancel out, and we are left to accept the President's statement and the rather vague but very general opinion that there is less of the spirit of adventure than there used to be; not only of that kind of venturing which draws men to strange lands overseas, but, as we think the President meant, of that which led young men in the last century to set up in business on their own responsibilities at an age when nowadays they would be regarded as little more than school-boys. Even that greatest and most hazardous of all adventures, matrimony, is now postponed until an age and a position have been reached when the risks of difficulties and hardships are thought to be passed.

May it not be said of any prosperous age that it is less adventurous than its predecessors? Peace, with the comforts and amenities of existence, wrap us around like the arms of an easy chair. The course is so easy, so smooth; the difficulties and obstacles are so reduced; the attractions to remain as they are are so great that men are unwilling to face certain hardships for an uncertain future. Consider but a single fact that drove many a young man seventy or eighty years ago to seek his fortune abroad—the discomfort and restriction of his life at home. Parents and schoolmasters were harsher, there were few evening recreations, hours of work were long, food was often unvaried and not overplentiful, heat and cold were not tempered by central heating and air conditioning, the opposite sexes were restrained in their relationship. We need not point to the differences in these respects at this day. Everyone is aware of them, and all must admit that inevitably they tend to make a nation of young people which is less inclined to seek new adventures than those of an age when youngsters faced hardships and hope abroad rather than continue under parental restrictions at home. Even amongst the working-class population which for many years emigrated freely, home, with the certainty of the dole and old-age pension, is more attractive than colonial life. That is one side of the picture. The other is that there is scarcely a nation in the world—not an important one in the whole British Empire—which from the bottom of its heart welcomes immigrants. Some profess to do so; but they set up so many obstacles and difficulties that they revoke by their actions what they say with their mouths. Finally, it must never be forgotten that the venturer to far lands takes, if not his life, his health in his hands; that he gives up his best years to the work, losing all his home contacts, and that when he retires, as he must at a fairly early age, he finds himself, often enough, a poor man with no prospects and with no chance of obtaining employment in a country which has forgotten him. Is it a matter for much wonder if with so much to keep them at home and with so little to draw them abroad, there is less of the spirit of distant adventure in the young engineers of to-day? Turn, now, to the other aspect of adventure to which we have referred. Many, if not most, of the great industrial firms upon which the reputation of this country was built up were founded by young men barely in their twenties. In the field of engineering it is almost inconceivable that such a thing could be done at this day. The conditions have changed in all respects. A multitude of advisers tell the would-be engineer that he must devote years to his training and education so that he may acquire qualifications which will appeal to employers. Following their instructions he fits himself to become an associate member of an engineering institution, finds a fairly easy and comfortable job, with fair prospects at home, and the spirit of adventure drops away from him. So in ninety-nine cases out of a hundred. The last is more ambitious; he would become a works owner at once. Think of the obstacles that stand in his path. It is hard to begin manufacturing in a small way in competition with huge factories; even if he employs but a few hands the factory inspector falls upon him with rules and regulations about light and air and fire-escapes; he has to pay insurance money; his men will not work for what he can afford to pay them, but only on trade union terms; he is rated highly, and much of his income is abstracted in taxes; he has to maintain a clerical staff and spend money on advertisement. All such things as these, the inevitable adjuncts of an advanced industrial civilisation, make this road of adventure so hard that few indeed trust themselves upon it.

Colonel Davidson deplored the decrease of the spirit of adventure amongst young British engineers, but we suggest that he would find the same forces which are defeating it here also at work in other already advanced countries. In some there is what might be called "mass" adventuring, but in few is "individual" adventuring as common as it once was. We may regret the passing of something which gave excitement and romance to our industry and profession, but we are compelled to recognise that the change is a natural sequel to the advance of civilisation. It has to be accepted as a fact and it is better perhaps to consider how we can make the best of the circumstances our progress has induced than waste tears on the passing of something we once held dear. The pioneer blazing the trail must be followed by the contractor building roads. The romance has gone; utility has replaced it. So it must be—for the general good—in nine hundred and ninety-nine cases out of a thousand; but the thousandth will always have the element of adventure. For young engineers there still remain possible adventures in the opening up of parts of the world that have so far defied the engineer; the development of water resources; the building of roads and railways; the fertilisation of arid and waterless areas; and the winning of minerals at impossible heights from intractable rocks. In all such things we are certain the young British engineer is ready to play his part. But he cannot venture without means; he must be backed and encouraged by the "merchant venturer."

Electricity Supply.

WHILE having great admiration for all who have helped to bring about improvements in electrical generation, Mr. J. M. Kennedy, whose presidential address to the Institution of Electrical Engineers we publish in abstract on another page, is not among those who believe that conditions prevailing in the electricity supply industry leave nothing to be desired. Despite the rate at which new consumers are being connected to public mains, the present is not, in his opinion, the time for complacency. Although during the last five years many new consumers have been acquired, he holds that reduced generating costs and new houses have been responsible for not far short of half the total gain. As far as lighting is concerned, supply undertakings have had to exert little or no effort to make builders electrically minded. Electrical propaganda does not therefore appear to have played such an important part in recent developments as is generally supposed; indeed, according to Mr. Kennedy, the real inroad into the potential consumers existing five years ago, has only been at the rate of 360,000, or approximately 3 per cent. per annum. It is well known that electric power developments have been largely associated with works and extensions of more or less recent origin. Just as new houses are now almost invariably wired for electric light at least, so are new factories generally equipped for electric driving. But there are large sections of industry that continue to derive their power from mechanical plant or generate their own electricity. With so much old power plant in service there is no reason to rest content, notwithstanding that the increased sales of electricity to date exceed the estimates on which the Central Electricity Board framed its tariffs.

It is, in one sense, unfortunate that in this country electricity and gas undertakings work hand in hand more seldom than in America. In another sense it may be regarded as advantageous to the user, who benefits by the rivalry. The establishment of the "grid" set up conditions in the electrical supply industry which are not found in the gas industry. The grid has to justify itself as a national concern, and at times electrical propagandists may be suspected of a greater desire to see more electricity consumed than of a wish to provide the consumer with heat and light and power in the most economical and convenient form. The effort to make the whole country electricity-minded is, of course, good business from the electrician's point of view, but if that psychological attitude is allowed to over-ride plain economics the country as a whole will not benefit. We need not remind our readers that a great many people who know little about electricity and still less about railways believe in the electrification of railways simply and solely because persistent propaganda has brought them to the state of regarding electricity in all its manifestations as the last word in progress. That, we submit, is not a really healthy attitude. If electricity supply is to flourish, until some newcomer drives it from its position, it must do so on its veritable merits, not on a psychological mass effect. We think Mr. Kennedy sees this, for he indicated pretty clearly that supply and utilisation were not all that they ought to be, particularly in the matter of distribution. He pointed out that the reduction in the cost of electricity to date has only been made possible by the reduction in the cost of generation, including capital charges. There has been no reduction in the cost per unit of distribution. If discussion on the address had been permissible it would probably have centred mainly round distribution, a subject on which Mr. Kennedy is known to hold rather unpopular views. The possible methods of obtaining improvements are summarised in the abstract of the address published elsewhere in this issue, but no reference is made on this occasion to the establishment of Distribution Boards. The hostile reception which that proposal met with when Mr. Kennedy put it forward in the paper he presented in conjunction with Miss Noakes before the I.E.E. in 1933 indicated pretty clearly that the industry has no desire for further official interference, although it does not, of course, follow that it will not be forced to accept it. Possible means of improving distribution are at present receiving official consideration. The co-operation between adjoining areas, referred to in the address, may suggest

to some that the Distribution Board idea is still afloat, and that another electricity authority is on the way. That the practice of grouping a number of small areas together will invariably lead to improved results all engineers do not believe. Nor is it by any means generally considered that the industry needs any further outside assistance.

The remaining proposals in the address are perhaps rather less liable to give rise to alarm. The second, advocating economy in design and construction of distribution systems, demands the attention of supply engineers and manufacturers alike. Cheaper distribution, especially in sparsely populated parts, is still a matter worthy of close attention. At present there is, as Mr. Kennedy says, a wide divergence in practice and design, resulting in material differences in the cost per mile of both underground cables and overhead lines. A free interchange of ideas and experience is therefore advocated. But it is to be hoped that practice in other countries will not be ignored, and that schemes which may appear a little unconventional, and perhaps rather less safe than those with which British engineers are mainly familiar, will be given a trial if conditions seem to favour them. Unduly stringent regulations governing rural line construction must be abolished. Let it be remembered that one and all have been promised a cheap supply, irrespective of locality. How that promise is going to be met in some cases we do not pretend to know. But certain it is that such consumers as isolated farms call for cheaper overhead distribution lines than those commonly employed in this country. Some such H.T. system as that advocated by Mr. Clough in our issue of August 5th, 1927, and utilised extensively in Canada and America, might, it seems, be given a trial where more or less isolated consumers call for consideration.

Institution of Electrical Engineers.*

It may certainly be claimed that the electrical industry as a whole has been helping to stem the tide of rising unemployment during the last ten years. The total numbers employed in manufacturing, contracting and supply have increased from about 200,000 to 330,000 in this period. In the supply section of the industry the increase has been rather more rapid, in spite of the co-ordination of generation brought about by the 1926 Act. The numbers employed in generation have remained practically constant during the last eight years, whereas the numbers engaged on distribution and administration have more than doubled. As the closing down or limitation of output of generating stations is bound to result from time to time in a reduction of *personnel* in individual cases, every effort should be made to train the labour so displaced so that it can be transferred effectively as opportunity arises.

Any speeding up in the development of electricity supply, both for domestic and industrial purposes, will bring in its train a large amount of work, both for the manufacturing and contracting branches, and will obviously have a favourable reaction on the question of unemployment. Railway electrification, too, has an important bearing on this question. It has been estimated that any comprehensive programme of railway electrification would employ directly or indirectly over 100,000 men, which would be no mean contribution to the solution of unemployment, and although it must be admitted that the ultimate effect would be to reduce the number of permanent railway employees for any particular programme of train mileage, yet the potential and probable increase in services, coupled with the additional *personnel* required on electrical works, would go a long way to counterbalance this disadvantage.

As any comprehensive programme of railway electrification would probably be spread over a period of ten to fifteen years or longer, I do not consider that the ultimate results on employment or coal consumption need cause any apprehension, and it would certainly help employment during the period of construction.

Price and Generating Costs.

The help which electricity can give, and is, in fact, under a moral obligation to give, to the solution of social problems depends upon its greater availability and a reduction of its cost. My critics will no doubt point with pardonable pride to the growth of the electric supply industry in the last decade, and I would be the last to decry in any way what has been achieved. Let us pause for a minute and see what has been accomplished. In the period 1924 to 1933 the sales of units by authorised undertakers in Great Britain have increased by 163 per cent., the average revenue per unit sold for lighting, heating, and cooking has decreased from 4·20d. to 2·27d., and the average revenue per unit sold for all purposes has been reduced from 1·85d. to 1·37d. But if we analyse these figures we find that this reduction of 0·48d. per unit in revenue has only been possible owing to the reduction of the total costs of generation, including capital charges, from 0·97d. to 0·52d. per unit sold, and a small reduction in the amount per unit set aside for the relief of rates. There has been no reduction in the cost per unit of distribution. It certainly seems evident that on the generation side the industry, in conjunction with the Central Electricity Board, which is, of course, an integral part of the industry, can be said to have put its house in order. The full economies of the grid system have not yet been realised, and it may be confidently anticipated that some further reduction of generating costs will be brought about in the next two or three years, resulting from more effective control of the stations in all regional areas and from the reduction in the percentage of spare plant to a working margin of, say, 20 per cent. over the aggregate maximum demand. Although such further reductions can only be of minor significance as compared with the reduction achieved in the last ten years, it is, nevertheless, essential that the best possible use should be made of our nationally co-ordinated system of generation.

In so far as the interconnection is to be justified by the reduction in spare plant capacity, it is obvious that it will take several years before the reduction can be effected, but it may be of interest to point out that whereas in the years 1929 and 1930 the spare plant as a percentage of the aggregate maximum demand was 83 per cent., it has been gradually reduced to 82, 79, and 62 per cent. respectively in each of the three succeeding years. This reduction of 21 per cent. since 1930 represents a freeing of approximately 1,000,000 kW of plant which would otherwise have been kept in reserve. If we put the cost of that plant at a net figure of only £10 per kW,

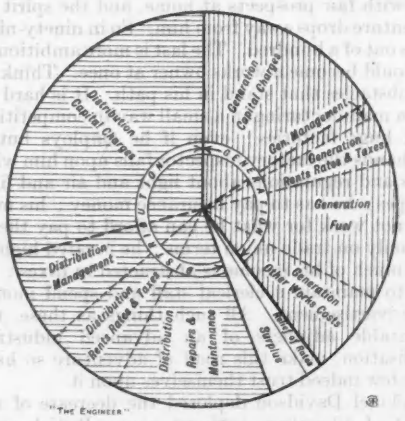


FIG. 1—REVENUE DIAGRAM

it appears that a saving of £10,000,000 has already been brought about, or more than one-third of the whole cost of the grid.

With the further reduction in spare plant capacity to a figure of, say, 20 per cent., it will be clear that the net value of plant which is freed for commercial operation will be in excess of the whole cost of the grid, and very considerable additional economies will result from the co-ordinated control of all generating resources.

In order to consider what further improvements can be effected, I would draw attention to Fig. 1, which shows how the total revenue from working is appropriated. Capital charges as a whole account for practically half the total revenue and a preponderating part of the revenue is absorbed in distribution costs. It may be interesting to point out here that the annual turnover of the electric supply industry only amounts to 15 per cent. of the total capital expenditure, whereas in the gas industry the turnover is over 30 per cent., and in the Post Office the revenue is over 45 per cent. of the capital expenditure. Of these percentages, capital charges represent about 7 per cent., and it is clear therefore that they are of far greater relative importance in our industry than in the other two cases which I have quoted.

The importance of obtaining capital at the lowest possible price is evident from the simple statement that if the charges could be reduced by 1 per cent. on the capital expenditure, the average revenue per unit could be reduced by nearly 7 per cent.

Distribution.

Allowing for any possible reduction in the cost of generation capital and for any further reduction in operating costs due to co-ordination, the improvement which may be effected in this direction must be small compared with what has already been achieved. To maintain or accelerate progress, therefore, we must look to the distribution side to effect the necessary economies. Possible improvements in distribution may be summarised under the following heads:—(1) A reduction in capital expenditure by co-operation between adjoining areas; (2) a reduction in capital expenditure by economies in design and construction; (3) a reduction in the percentage relationship of annual distribution costs to capital expenditure; (4) an increase in the number of units sold per £ of capital expenditure.

With reference to the first point, there is no doubt that some economy in capital expenditure can be effected by co-operation between undertakers whose areas adjoin in giving supplies to streets or villages on or near the boundaries, especially in those cases, which are rapidly increasing in number, where the magnitude of the demand warrants a duplicate supply. As regards my second point, there is still a very wide divergence in practice and design among different authorities, which brings about very material differences in the cost per mile, both of underground cables and overhead lines. A freer interchange of ideas and experiences is obviously desirable, and we may hope that our newly formed Transmission Section will be of material assistance in this direction. Can we not also reduce the costs of manufacture of apparatus by bringing about a greater measure of standardisation, especially in the design of cookers, on which so much thought has been expended, but upon which so many differing ideas are still held.

As regards the third point, I would draw attention to Fig. 2, which shows a fairly straight-line relation-

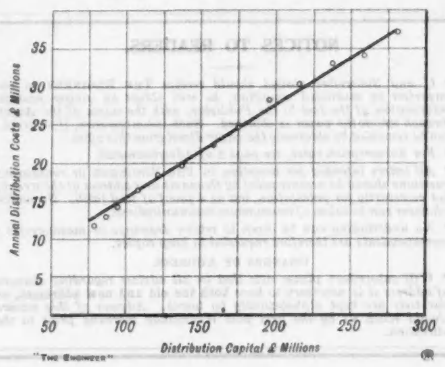


FIG. 2—RELATIONSHIP BETWEEN DISTRIBUTION COSTS AND CAPITAL

ship between the annual distribution costs, including capital charges, and the capital expenditure. In the first year, the costs represented approximately 15 per cent. on the capital and in the last year 13 per cent. I have already referred to the need for reducing capital charges which are such a large proportion of the total costs. The cost of administration must be carefully overhauled to see that all possible economies are effected. It is also essential to reduce tariffs in order, so far as possible, to eliminate surplus profits, and thus obviate unnecessarily high assessments for income tax and local rates.

The fourth and probably most important point is the sale of a larger number of units in relation to the capital expenditure. Assuming that the distribution costs can be reduced to 12·5 per cent. on the capital, 30d. are required annually to meet the costs and charges incidental to each £ of capital expenditure, and therefore if only 30 units are sold per £ of distribution capital, the distribution costs must be 1d. per unit. In the last ten years the units sold per £ of distribution capital have fallen from 48 to 41, but this has to some extent been counterbalanced by the reduction, which I have already mentioned, in the percentage relationship of costs to capital, and the result has been a small increase in distribution costs from 0·76d. to 0·77d.

There may no doubt be many arguments put forward to account for this lack of improvement, among which might be mentioned the spreading of supplies into rural areas and the connecting up of a considerable number of consumers with a lower average income than those previously supplied. I am not at all sure, however, that the former contention is correct; an investigation recently made shows that the capital expenditure per consumer on transmission and distribution in some typical rural areas is less than in many urban areas. Also the capital cost per consumer, for the country as a whole, has decreased steadily each year, in spite of the spreading into rural areas. It is obviously impossible to make any generalisation in this respect, but I have always maintained that the much lower cost of overhead transmission and distribution in rural areas would go far to balance the lesser number of consumers per mile. As regards

*Abstracted from the Presidential Address delivered by Mr. J. M. Kennedy before the Institution of Electrical Engineers on Thursday, Oct. 24th.

the latter contention, whereas it is true that the consumption of the consumers with a lower average income should normally be less than of those more fortunately placed, yet the present average overall consumption per consumer for lighting, heating, and cooking is only about half the potential requirements of the smallest household for lighting and cooking only. It would appear therefore that if sufficiently attractive tariffs were offered, there would be every reason to anticipate a substantial increase in the average number of units sold both per consumer and per £ of capital.

Small Cause for Complacency.

I cannot stress too strongly the need for careful and systematic investigation into all these suggested methods of improvement, on which depends the successful development of the electric supply industry. I know that many critics will say that there is no need to worry; that sales are increasing sufficiently fast; that just over 3,000,000 consumers have been connected up in the last five years; and that generally the industry is in a very flourishing condition. While certainly not denying these statements, I venture to suggest that the position is not quite so satisfactory as they might lead one to suppose. In the first place, although the last five years have admittedly seen a large increase in the number of consumers, it must be recognised that in this period over 1,000,000 new houses have been built, which, with the accompanying new shops, offices, and other incidental premises, represent, say, 1,200,000 potential consumers, the bulk of which must have become actual consumers for lighting at any rate, in all areas where supplies are available, with little, if any, sales effort on the part of the electricity supply undertakings. Consequently, the real inroad into the potential consumers who existed five years ago has only been at the rate of 360,000, or approximately 3 per cent., per annum. The present position, as I see it, is that although progress in the past few years has been, on the whole, satisfactory, it has had the adventitious aid of steadily reducing generation costs, coupled with a programme of new house building which has probably accounted for not far short of half the total gain in consumers.

Although the increase in sales to date has exceeded the estimates on which the Central Electricity Board framed its tariffs, and we have no apprehension therefore as to the financial result, the present is not the time for complacency if the industry is to be of real help in solving the problems to which I have referred. It must always be remembered that the progress which has so far been achieved relates in the most part to supplies to those who have most money to spend. The nearer we approach to saturation, the greater will be the difficulty of maintaining the same rate of progress without more intensive effort and in the majority of cases with an appreciable reduction of tariffs. But to my mind one of the greatest dangers of complacency at the present time is the phase of keen competition upon which we are now entering, both for the domestic and industrial loads. Doubtless our strongest rival in the domestic field is the gas industry, and one cannot but feel admiration both for their originality of ideas and for their imitative ability.

Another form of competition which is certainly proving attractive to some potential consumers is the slow combustion stove, for which the manufacturers are prepared to guarantee a maximum yearly cost of fuel. With the heat storage type of electric cooker, of course, there is no reason why a supply authority should not give a similar guarantee, and although it may be an impracticable ideal to offer the same guarantee in connection with the more usual form of electric cooker, it is obviously a point which would appeal to many potential consumers.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

ISCOR IRON AND STEEL WORKS.

Sir,—With reference to an article by your South African correspondent, printed in your issue of September 20th, I am enclosing herewith a correct and authoritative statement of the position of the Iscor Iron and Steel Works of this Corporation, situated at Pretoria.

The Iscor Iron and Steel Works at Pretoria, belonging to the South African Iron and Steel Industrial Corporation, Ltd., comprise a coke oven and by-product plant, blast-furnace plant, steel melting shop, section rolling mills and sheet rolling mills. The production of steel at these works therefore involves all the processes from coal and iron ore to finished steel.

The various producing departments were brought into production during 1934. By September of that year all departments were producing with the exception of the sheet mills, which were a later addition and which started producing in April, 1935.

The total capital invested in the concern is £6,000,000, of which £1,500,000 represents 5 per cent. debentures and £4,500,000 represents ordinary shares. The capital is invested in the Pretoria plant, in three iron ore and dolomite mines, in a lime quarry, and in subsidiary industries, such as the Union Steel Corporation (of S.A.), Ltd.

For the year 1934 Iscor returned a loss of £266,000. A large proportion of this loss could have been debited to capital account, since it represents what is ordinarily known as starting up expenses, *i.e.* expenses incurred before the various departments can earn revenue. These expenses were, however, debited to profit and loss account, the object being to avoid as far as possible debiting to capital account expenditure which does not represent tangible assets.

Since January, 1935, no further losses have been incurred on operation and since July, 1935, *i.e.*, ten months after the works as a whole came into production, substantial profits have been made and all departments, including the sheet mills, which only started producing in April, 1935, have been proved capable of producing at rates in excess of normal capacity.

The works have never ceased producing since they started up and most of the products, *i.e.*, coke, by-products, pig iron, sections, rails and black and galvanised sheets, are being disposed of on the Rand and in neighbouring territory.

A proportion of the output of the works is sold to the Government Railways at prices at which the railways can land imported steel at the coast. In respect of the sales to the railways, therefore, the steel works do not enjoy the natural protection due to its geographical situation in the interior of the Union.

Steel products of the range produced at Pretoria are not subject to customs duty when imported from Britain, while on foreign steel the duty is only 3 per cent. Since the Pretoria products came on to the market considerable quantities of steel have been dumped from certain foreign countries, and in respect of some of these countries the existing dumping law has been applied.

The dumping of steel has naturally had an adverse effect on the trading position of Iscor, but in spite of this Iscor has now reached the profit-earning stage and its products are being very well received on the South African market. The principal buyers, such as the gold mines, merchants, manufacturers, &c., appreciate that Iscor manufactures only to British Standard Specification, this being one of the main reasons why Iscor products find a ready market.

The present productive capacity of the Pretoria Iron and Steel Works is indicated by the following statement, which gives the quantities produced during July, August, and September of this year:—

Product.	July.	August.	Sept.	Average.
	Tons.	Tons.	Tons.	Tons.
Coke	13,772	13,807	13,443	13,700
Pig iron	16,316	17,977	18,087	17,460
Ingots	18,679	18,808	17,967	18,484
Heavy sections and rails	17,271	16,291	14,984	16,182
Light sections	2,627	2,794	3,393	2,938
Sheets	1,689	1,172	2,648	1,836

Ton = 2000 lb.

Considering the difficulties encountered in establishing a comprehensive works in a country to which steel making was entirely foreign, and the short time that the works were in operation before reaching a profit-earning stage, one cannot do otherwise than regard the undertaking as very successful.

H. J. Van der Bijl, Chairman,
S.A. Iron and Steel Industrial Corporation, Ltd.
Johannesburg, October 15th.

RAILWAY ACCIDENTS.

Sir,—I was very much interested in reading your report of railway accidents, especially referring to the reduction of accidents from 1924–1935, compared with former years.

I have wondered if the alteration in the shape or contour of the locomotive wheel flange had anything to do with the improvement, as, I understand, the change took place in 1925. In my opinion the alteration was for good. The old flange was far too often running in a condition that was considered dangerous by responsible running shed men and liable to jump the rails.

I certainly have not read for some years back of so many accidents by engines jumping the rails.

October 26th. Still Wondering.

SIXTY YEARS AGO.

There is much of surviving interest in a series of articles by Mr. John Bourne entitled "Recollections of Improvements which have been made in the Steam Engine during the last Half-century," the first of which appeared in our issue of October 29th, 1875. Bourne, a very well-known engineer in his day, entered the profession in 1832 and throughout his career enjoyed special opportunities for observation and inquiry in mechanical engineering circles. As a young man he found that it was difficult to obtain information concerning the steam engine. Fairey's treatise had been published but the first volume—the only one which ever appeared—was chiefly historical and mainly confined to descriptions of Smeaton's engines. The leading engineering firms, notably Boulton and Watt, pursued a policy of keeping whatever information they possessed as secret as possible. Mechanical engineering, indeed, was in danger of becoming a craft the knowledge of which would be restricted to a small number of persons. Bourne began his career by entering the works of Duffus and Co., of Aberdeen, then one of the largest engineering firms in Scotland. His father, Captain Bourne, had just placed an order with that firm for a steam vessel, the "Royal Tar," which was later to become celebrated as the pioneer ship of the Peninsular and Oriental Company. This vessel was at first fitted with square boilers which proved to be unequal to their task. When the engines were started the boiler pressure fell below atmospheric. There were no glass gauge tubes and the usual gauge cocks when opened drew in air instead of emitting water. The position of the water level inside the boiler had accordingly to be determined by striking the boiler front with a hammer. In those days Whitworth's influence on workshop practice had still to be exerted. In Messrs. Duffus' works—and in those of Messrs. Caird, Napier and others—there was in 1832 neither a planing machine, a slotting machine nor a slide lathe. Metallic straight edges and surface plates were scarcely known. As an example of production methods Bourne described the method employed of bringing a valve face to a flat surface. A narrow strip was first chipped at each end and to these strips short wooden straight edges were applied in order to determine by eye that the surface was not twisted. Thereafter the surface was chipped all over and was subsequently filed, prominent parts being marked by means of a wooden surface plate and eased with the file. The cylinder face was dealt with in the same way. Finally the cylinder and valve faces were ground together with the aid of fine emery and subsequently with powdered oil stone. In 1833 Bourne left Aberdeen and entered Caird's works at Greenock. At that time there was keen competition on the Glasgow-Liverpool route between the Burns and McIver lines. The Burns vessel "Manchester" with Caird engines was pitted against the McIver vessel "Vulcan" with Napier engines but gave at first a disappointing performance. She was always short of steam and it was proposed to fit her with larger boilers. A workman formerly in the employment of Boulton and Watt recommended that the valve should be given lap in order to cut off the steam before the end of the stroke, thus working the engines expansively. The effect of adopting this proposal was "magical" and for a time Cairds made a mystery of it, so much so that it was commonly believed that they had made some new discovery concerned with the operation of steam engines.

Literature.

SHORT NOTICES.

Alternating Current Practice. By Claude Cook. London: Crosby Lockwood and Son, Ltd. 1935 Price 9s. 6d.—The title of this book as it appears on the cover is apt to lead one to suppose that the volume is merely another addition to the large number on alternating current work written mainly for the benefit of students. But, as the preface indicates, it is intended to cater for other classes of readers, particularly men associated with installation work. While the requirements of students have not been neglected, the author's aim has mainly been to provide material helpful to wiremen and installation engineers more familiar with D.C. than A.C. In view of the many changes over that have been made from the former to the latter and the continuance of that practice, a need has arisen for extended knowledge on the part of those responsible for the installation of motors and other electrical plant. This the author endeavours to provide by dealing with A.C. circuit and machines in simple and straightforward language and without the help of the mathematical expressions met with in most books bearing similar titles. As it has not yet proved possible to dispense entirely with D.C., and as it is not uncommon practice when D.C. supplies are abolished to convert the incoming A.C. in factories and other establishments, special attention is paid to rectifiers and converters employed for that purpose.

Mercury Arc Rectifier Practice. By Frederick Charles Orchard. London: Chapman and Hall. 1935. Price 15s.—Since mercury arc rectifiers began to be employed instead of converting machinery on public electric supply and traction systems a great deal has been written about them. Both in this country and abroad the theory, design, and construction of power rectifiers have been dealt with in articles, papers, and books. But as the power rectifier is a relatively new piece of apparatus as compared with the converters that were previously invariably used, it has naturally undergone improvements and modifications. Much that has been published about rectifiers is therefore more or less out of date or, at any rate, does not cover all the very latest developments. But here is a book that not only avoids the necessity for much laborious work in the way of searching for and wading through publications issued in the past, but which also deals with rectifiers as they now exist. Grid control, for example, receives due consideration and all the applications it has made possible, such as voltage control, frequency changing, and conversion from D.C. to A.C. are described. The book has been written to fill the gap between publications devoted to descriptions and the statement of elementary principles and those covering the scientific and mathematical theories involved. It should prove particularly useful to supply engineers who have not as yet familiarised themselves with glass and steel tank rectifiers suitable for use on public electricity supply systems. Written on simple lines and devoid of mathematics, it is essentially a practical man's book and should meet with a good reception in the electricity supply industry.

BOOKS RECEIVED.

The City and Port of Hull. Hull: The City of Hull Development Committee, The Guildhall. Issued free of charge.

Tools of To-morrow. By J. N. Leonard. London: George Routledge and Sons, Ltd., 68, Carter-lane, E.C.4. Price 12s. 6d. net.

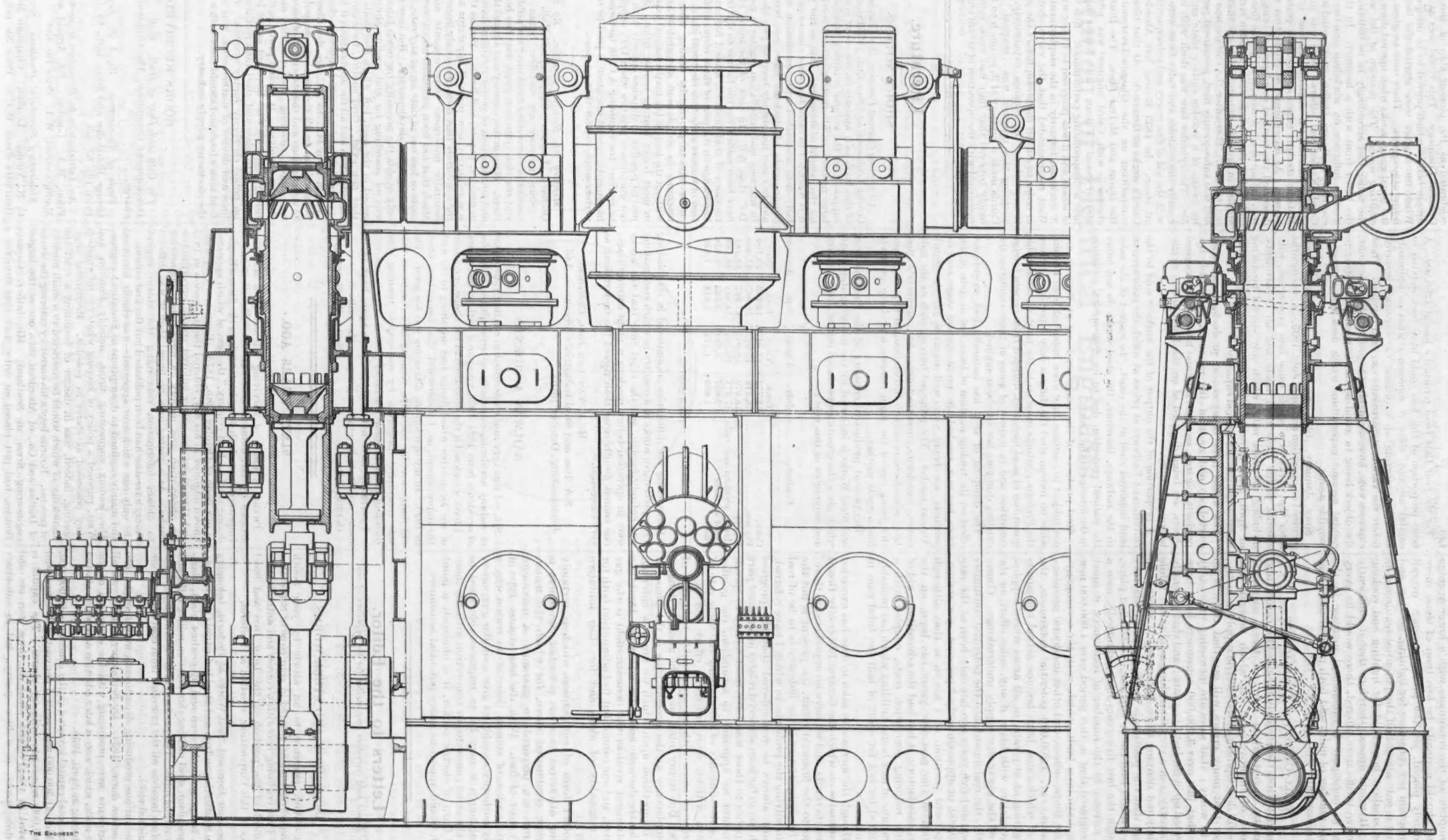
An Introduction to Projective Geometry. By L. N. G. Filon, M.A. London: Ed. Arnold and Co., Ltd., 41, Maddox-street, W.1. Price 16s. net.

Elementary Structural Problems. Second edition. By C. R. Young. London: Chapman and Hall, Ltd., 11, Henrietta-street, W.C.2. Price 20s. net.

FIVE-CYLINDER 3000 S.H.P. OPPOSED PISTON ENGINE FOR THE M.V. "DILWARA"

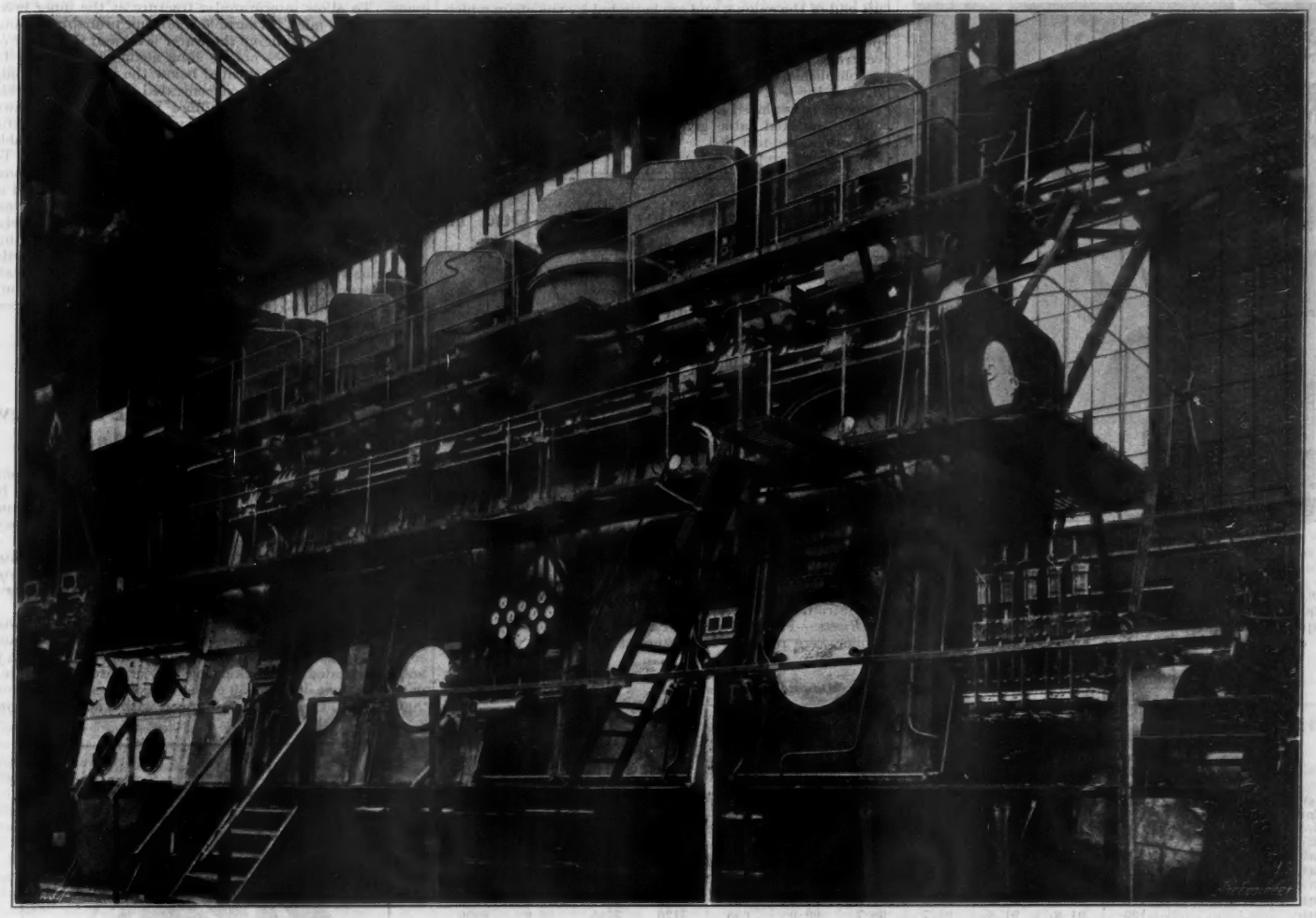
BARCLAY, CURLE AND CO., LTD., GLASGOW, ENGINEERS

(For description see opposite page.)



FIVE-CYLINDER OPPOSED PISTON ENGINE FOR THE "DILWARA"

BARCLAY, CURLE AND CO., LTD., GLASGOW, ENGINEERS



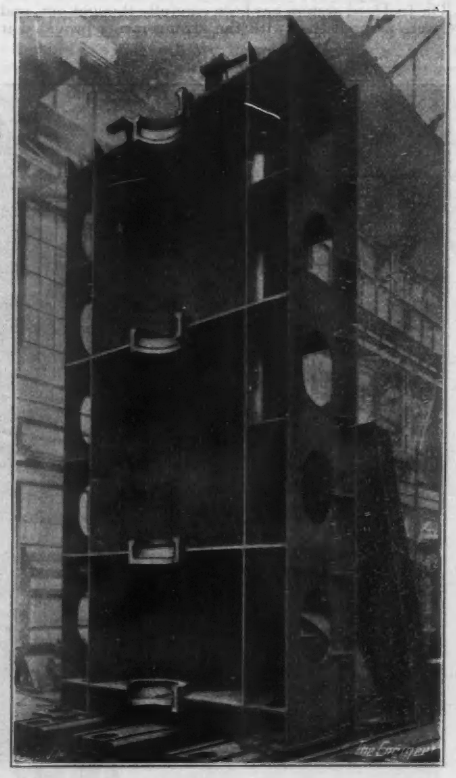
Engines for the TS. M.V. "Dilwara."

WE had the pleasure to inspect recently at the North-British Engine Works of Barclay, Curle and Co., Ltd., Glasgow, two sets of five-cylinder Doxford opposed-piston engines which are being built for the British India Steam Navigation Company's twin-screw ship "Dilwara," now under construction by Barclay, Curle and Co., Ltd. One of the engines was still in the erectors' hands, but the other was running on a brake load. Owing to its design, the opposed-piston engine is exceptionally lofty—slightly over 25ft. overall in this case—and on that account might be expected to give those signs of vibration to which Mr. Ricardo referred humorously in a celebrated lecture. As a matter of fact, there was no visible movement whatever, and climbing all over the engine from base to summit and from forward aft, we were unable to find any vibration at full speed. There is a peak at a relatively low-speed, but the vibration caused by it is small, and it is passed through rapidly on starting up. Thereafter the special measures taken to reduce torsional vibration—the Doxford-Bibby detuning fly-wheel—appeared to be perfectly successful. An interesting verification of this observation is provided by the untouched photograph reproduced above. It shows the engines running at 118 r.p.m., and the exposure was no less than three minutes. The sharpness of all the details is a testimony to the steadiness of the machine.

This photograph unfortunately gives the reader but a poor idea of the size of the engines, the first five-cylinder Doxford engines to be built for a ship. The cylinders are 560 mm. bore and the stroke of the upper piston is 700 mm., and of the lower 980 mm., giving a combined stroke of 1680 mm. They are designed to develop together 6000 s.h.p. at 120 r.p.m., and the makers anticipate that the consumption on service will not exceed 0·355 lb. per b.h.p.

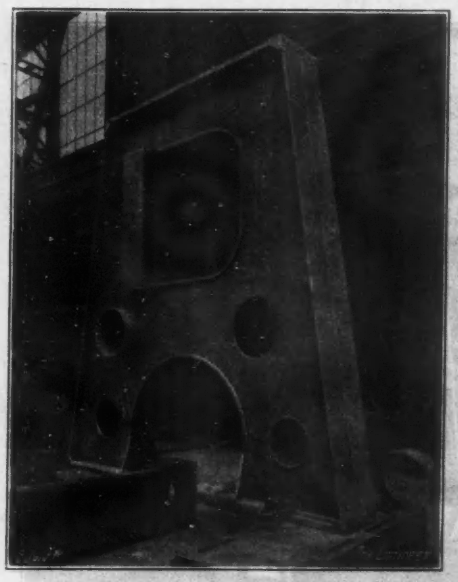
There are many interesting things about the engines, but the most notable is the fabricated frame and crank case. These are so well shown by the three photographs reproduced herewith that little more need be said about them. The welding—bedplate, columns, and entablature—was done electrically throughout and finished completely in the maker's works. It has saved nearly 8ft. in length as compared with equivalent castings, and, of course, a considerable amount of weight. Moreover, the makers inform us that the fabricated frame has proved to be more rigid than older designs, and has made it possible to give a more uniform flow to the scavenge air, which tends to improve fuel consumption. We were greatly interested in the piston itself, shown on the left in a view

FORWARD SECTION OF WELDED ENTABLATURE



SECTION OF BEDPLATE, PARTLY WELDED

below. It is cut out from a solid block of steel, and is bolted to the cast iron skirt shown on the right in the same illustration. The form is seen more clearly in the longitudinal section on page 460. The ring groove cut in



MAIN COLUMN PARTLY WELDED

the face to relieve heat stresses will not escape observation. Another interesting detail is the use of flexible hose for the upper piston cooling water supply. It gets over the difficulty of elbow or telescopic pipes, and is cheap and easily renewable. The cooling pipes for the lower piston are of the elbow type as seen in the drawing.

The fuel feed system has been carefully thought out, and we were assured that with the arrangements provided it is easy to secure the development of substantially equal power by all five cylinders.

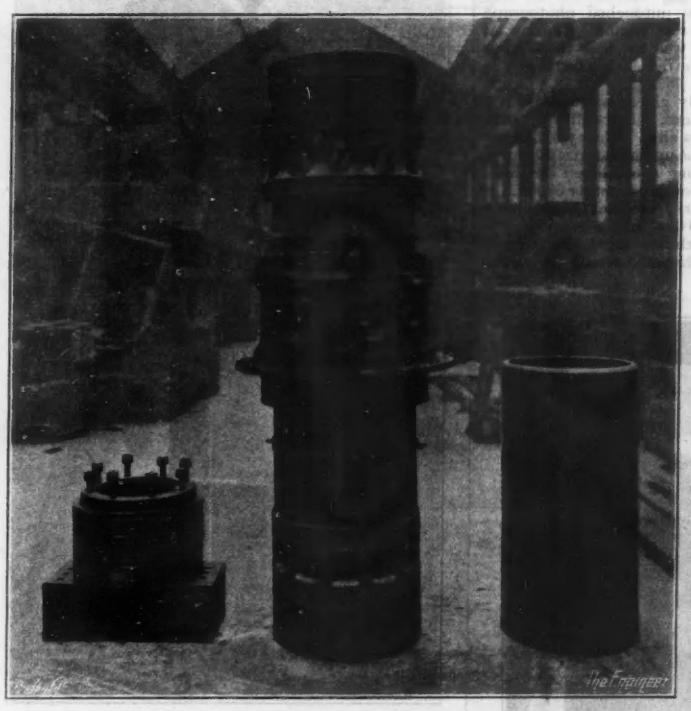
The reversing gear is seen in the centre of the engine, with the gauge board above. The reversing levers are completely interlocked and reversal is effected with surprising rapidity.

The fuel valve operating gear has also been improved, whilst the front and rear cam shafts are roller chain driven, and run in grease-lubricated bearings. Ball bearings have been adopted for the manœuvring shafts and the entire gear is almost noiseless in operation. The fuel pumps are situated in the usual position over the thrust block at the aft end of the engine, and are actuated by the chain which operates the cam shafts—see drawing. The scavenge pump for each engine is crank driven, and is arranged centrally between Nos. 3 and 4 cylinders. Priming is accomplished by means of a small high-pressure pump driven by a 2 b.h.p. electric motor with the starter conveniently placed at the control platform.

The annexed table gives the results obtained by the makers on the test bed.

Barclay-Curle-Doxford Engines for M.V. "Dilwara" : Makers' Tests.

Reading.	Revs. per minute.	Mean indicated pressure in lb. per sq. in. No. 1 cyl.	No. 2 cyl.	No. 3 cyl.	No. 4 cyl.	No. 5 cyl.	Exhaust temp. in deg. Fah.	B.H.P.	I.H.P.	Mech. eff., per cent.	Fuel injection in lb./sq. in.
1st hour	120	86·4	89·1	90·0	94·5	90·0	591	3000	3444	86·9	6800
2nd ,,	120	88·2	90·9	86·4	94·5	90·0	602	3059	3445	88·6	7400
3rd ,,	119	88·2	91·8	97·2	94·5	89·1	624	3079	3501	87·6	7200
4th ,,	119	90·0	92·7	93·6	95·4	87·3	625	3100	3485	89·0	7200
5th ,,	117	90·0	91·8	93·6	95·4	88·2	629	3042	3422	89·0	7400
6th ,,	118	91·8	92·7	93·6	94·5	90·0	631	3062	3481	87·8	7200
7th ,,	118	92·7	94·5	94·5	91·8	90·0	632	3062	3487	87·8	7200
8th ,,	118	90·0	94·5	93·6	91·8	90·0	637	3082	3460	89·4	7000
9th ,,	120	91·8	91·8	92·7	96·7	90·0	638	3120	3545	88·0	6900
10th ,,	121	90·0	89·1	94·5	94·5	89·1	639	3122	3524	88·6	7300
11th ,,	118	90·0	89·1	94·5	96·3	90·0	632	3025	3461	87·3	7300
12th ,,	119	91·8	88·2	94·5	96·3	88·2	640	3095	3497	88·5	7400
Averages	119			91·6			627	3115	3535	88·2	7191



PISTON, CYLINDER LINER AND SKIRT

Failure of a Boiler Plate Due to Chemical Embrittlement.*

THE failure took place in the second ring seam of a Lancashire boiler twenty-eight years old. The ring seams were lap jointed with two rows of rivets, the plate thickness being $\frac{7}{8}$in., and failure occurred over a large area below the water level.

Plate.—The sample received was cut from a part where cracks had been set up between seven neighbouring rivet holes in the outer row of the outer lap. The plate was of good quality and the micro-structure normal. It contained a multiplicity of cracks running from the inner surface of the joint commencing at the rivet holes. These were all intergranular and surrounded by an intergranular network of fine cracks, which in plate of good quality suggests chemical embrittlement. The landing contained a white deposit, which, when analysed, was found to consist mainly of sodium carbonate, giving evidence that the cracks had been subject to the influence of water favourable to the formation of embrittlement cracks in highly stressed steel. The portion of the plate received was too small and too much damaged to allow its being tested for overstrain at the rivet holes.

Rivets.—Portions of eleven rivets removed from the boiler were received for examination. These were made of good quality mild steel. Of these samples, three only included heads that had lain at the outside of the seam. As the outer heads were free from cracks, they were useless for giving evidence of embrittlement, yet it is the outer heads that, as will be shown, are the better able to give evidence.

Eight samples contained inner heads. Of these, six were free from cracks, one was severed from the shank and the other almost severed. Sulphur prints showed that cracks started from opposite sides of the fillet, and in one the crack divided up into two paths. The course of these cracks was cross granular. The micro-structure of the rivets gave evidence of cold work, and fracture had resulted from overstress alone.

Comparative Liability for Rivets to Suffer from Chemical Embrittlement.—That cracks in a plate may be of the embrittlement type and yet cracks in the inner heads of rivets may be cross granular is not conflicting evidence where chemical embrittlement is suspected. Assume that the inner heads of cracked rivets have been tight and have not allowed seepage, seepage could still have taken place to the exterior of the seam *vid* the inner end of the lap, and thence through the outer end of the lap, or even round the outer heads of any rivets not quite tight. In this alternative it is not possible for cracks in inner heads to be intergranular. Or, again, if the fit of the inner heads of cracked rivets has allowed access of the boiler water to the fillets, but the shanks have been sufficiently tight to prevent leakage, the boiler water will have been in full contact with the inner fillets, and no concentration can have taken place there; that is, provided that the heads have lain below the water level. In this alternative also it is not possible for cracks in inner heads to be intergranular. In both alternatives, however, cracks at outer heads are situated so that they can suffer from embrittlement. To allow intergranular fracture at the inner head of a rivet the most favourable condition probably obtains when the head lies above the water level and the whole of its inner surface does not lie snug against the plate. In this instance, liquid deposited below the head by priming or ebullition can become concentrated. As the two rivets that actually failed at the inner head were withdrawn from below the water level, they were unable to give useful evidence. None of the samples was therefore suitable for giving evidence on chemical embrittlement. To obtain evidence of embrittlement from rivets, the most favourable condition obtains when cracks have formed in the outer heads. The outer heads of representative rivets should then be broken off with a set, or, alternatively, where possible, the rivets should be removed by cutting away the inner heads and hammering the shanks outwards.

Conclusion.—The evidence obtained from the plate points strongly towards chemical embrittlement. A compound made up of caustic soda and tannin had been used for treating the water.

* From the Technical Report for the years 1933–34 of the British Engine Boiler and Electrical Insurance Company, Ltd.

A Small Milling Machine and New Automatic Turning Machine.

THE milling machine of which we give a photographic illustration herewith has recently been produced by Alfred Herbert, Ltd., of Coventry, especially for finishing comparatively small articles rapidly and accurately. It has a longitudinal feed of 4in., a transverse feed of 2½in., and a maximum height from the table to the centre of the spindle of 5½in. The longitudinal feed can, however, be increased to 9in. by substituting a hand wheel and screw feed for the rack and pinion gear we illustrate.

An outstanding feature of the machine is the fact that the cutter spindle is driven directly by an electric motor, so that no gears are involved. This motor is of ¾ h.p. and is intended for working on two or three-phase alternating current of 25 or 50 cycles at voltages ranging from 200 to 500. The motor is equipped with a speed changing

SMALL MILLING MACHINE

switch, which stands out prominently in the illustration, that gives spindle speeds of 440, 960, 1465, and 2945 r.p.m. when working with a 50-cycle supply, or speeds of 440, 710, and 1465 with 25-cycle current.

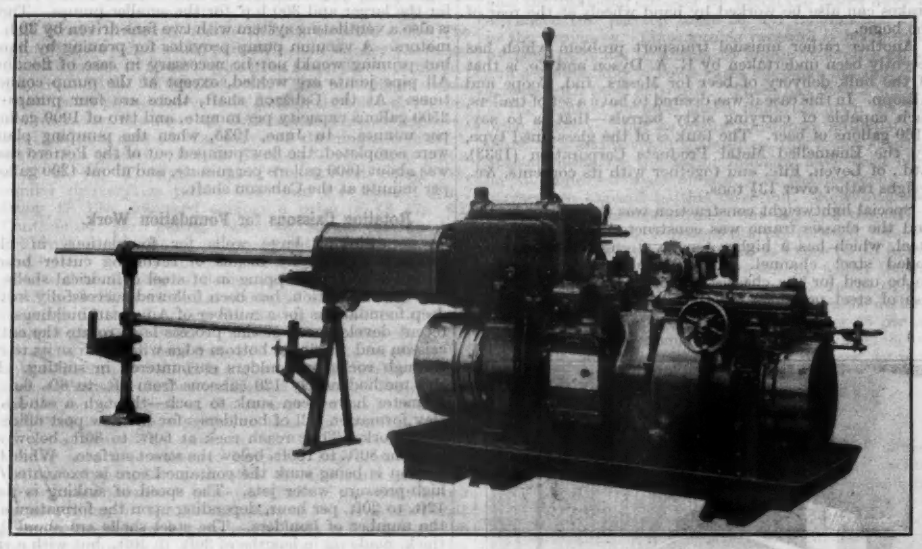
The spindle is mounted on precision type ball and roller bearings and carries a fan for cooling the motor. Protected openings in the end covers prevent the ingress of swarf. The spindle has a drawback collet chuck for holding parallel shank cutters or, alternatively, can have a quick non-sticking taper for holding arbors.

The knee for carrying the work table is moved by a rack and pinion and an adjustable hand lever and can be clamped in position. It is counterbalanced by a chain and weight inside the column. Adjustable stops limit movement in both directions. The saddle is moved by rack and pinion and an adjustable hand lever, and can be clamped in any position. The table is moved by rack and pinion and adjustable hand lever. Adjustable stops limit travel in both directions. The saddle and table have taper gibs. In the case of machines with screw feed the various movements are effected by hand wheels and screws.

Our second and third engravings illustrate another recent production of Alfred Herbert, Ld., namely, a new single-spindle turning machine for the high-speed production of work up to 4½in. long from 1½in. bar. It is intended for work on either steel or non-ferrous metals and consequently has a very wide speed range—from 25 to 1965 r.p.m.

The drive is effected by a 5 h.p. electric motor of the flange-mounted type, which is bolted on to the back of the headstock, as can be seen in one of our illustrations. This motor is controlled by a push-button switch arranged in a convenient position on the front of the headstock. The power is transmitted to the spindle through pick-off gears and friction clutches, the final stage being through a worm and wheel. There are two sets of gears, one giving four speeds of 25 revolutions upwards for screwing and the other giving six speeds from 287 revolutions upwards for turning, &c. The motor itself can be for two or three-phase circuits and runs at 1430 r.p.m.

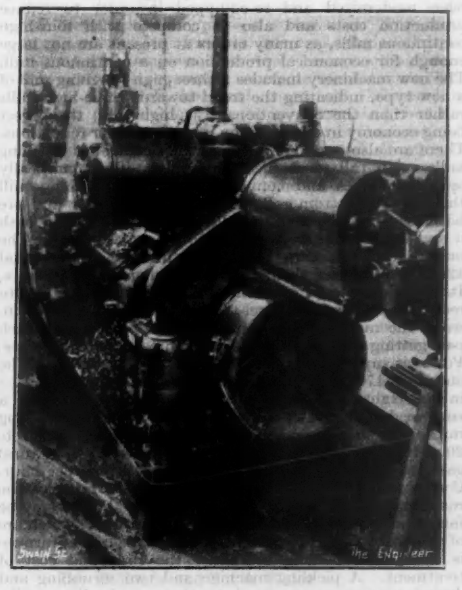
The main spindle is mounted on roller bearings and



NEW AUTOMATIC TURNING MACHINE

double purpose ball bearings. It is case-hardened and the nose has a taper hole for the chuck collet. The nose is covered by a guard. All the shafts and the loose clutch gears in the headstock are mounted on ball or roller bearings. A pump supplies oil from a reservoir in the bottom of the headstock to a tray at the top, where it is filtered and allowed to cascade over the gears, bearings, and other mechanism. A sight glass allows the circulation of oil to be observed.

The mechanism for chuck operating and bar feeding is carried on a tail rod in the form of a double slide. The chuck is opened and closed through an anti-friction slider operated from the cams on the chucking drum. There are no rubbing surfaces in contact at high speeds. The bar feeding mechanism is of a patented type, which works without shock and without any tendency to overfeed the bar. It also embodies a patented device by which the motions of the turret and cross slides are stopped when



REAR VIEW OF HEADSTOCK

the stock is used up and a red light indicates that new bar stock is required. The feed tube swings forward to allow new bar stock to be inserted from the front. When new bar stock is inserted it can be held firmly while the feed collet is forced over it, without it being necessary for the operator to go to the extreme rear of the machine. Both chuck closing and bar feeding mechanisms are covered by hinged guards and can be operated by hand when setting up the machine. The rear end of the bar runs noiselessly in a rotating rubber-lined tube. A needle roller bearing at the rear of the spindle carries revolving support bushes for round and hexagon bar stock.

The turret slide is mounted directly on the bed, being guided by a prismatic way at the front and a flat way at the back. It is held down by gibs at both front and back. The ways of the bed are completely protected in all positions of the turret slide. The turret has four faces and the tool holes are relieved for rather more than half their circumference to enable tools to be inserted and removed easily and to prevent wear of the holes.

The cross slides are independent, the lower slides being bolted to facings on the bed in front of the chuck. The upper slides are actuated by levers pivoted in the bed, the length of stroke being adjustable. The lower ends of these levers are moved by cams on two discs mounted on the cam shaft. The discs are accessible through a door in the front of the bed and can be adjusted round the cam shaft to vary the positions of the cross slide cams in relation to the turret cams and also in relation to each other. After adjustment the discs are locked to the shaft.

The feed motion is driven by gearing and an enclosed belt from the main spindle. The idle motions are driven from the constant-speed shaft of the headstock by enclosed chain and gearing. The feed box, bolted to the back of the bed, provides four automatic feed changes. Changes are made by a series of adjustable pins in the circumference of the control drum, which is keyed to the cam shaft at its extreme right-hand end. The pins actuate a feed change lever which is connected with the gearing in the feed box. The feeds can be changed by hand when setting up the machine. The changes from feeding to idle motion and *vice versâ* are made through spiral and worm gearing with a dog clutch and overrunning friction ratchet in the feed box.

The mechanism is actuated by two series of adjustable dogs in the control drum. These dogs control the clutch in the feed box so that the main worm shaft is driven at a fast speed through spiral gears for the idle motions or slow speed through worm gearing and friction ratchet for the feed. The main worm shaft drives through a safety clutch the large phosphor-bronze worm gear bolted directly to the turret cam drum, thus ensuring a very smooth motion to the turret slide. The automatic feed is engaged and released by a crank on the feed bracket attached to the front of the bed, a hand wheel being provided to turn the cam shaft when setting up. A safety device disengages the hand wheel when the automatic feed is engaged so that it remains stationary. This part of the feed motion contains a slipping clutch which prevents danger which might be caused by overloading.

A Two-Ton Crane for Persia.

MOST Londoners must be familiar with the little ubiquitous cranes made by R. H. Neal and Co., Ltd., of Ealing, which are commonly used by contractors for comparatively small loads, but the one which we illustrate herewith is rather unusual. It has been made for the Anglo-Iranian Oil Company for work in Iran, Persia, and is capable of making a lift of 2 tons at a radius of 14ft. Alternatively, it can lift 1 ton at a maximum radius of 20ft.

As will be seen from the engraving, the crane is mounted on a lorry chassis of the standard 6-ton Albion make, with Dunlop pneumatic tires, 40in. by 10in., with twin tires on the rear axle. In this way it is enabled to travel long distances from one depôt to another at higher speeds than is possible with an ordinary type of self-propelling crane mounted on solid rubber tires.

The crane itself is a standard 2-ton model, except that some slight modifications have been made to meet the tropical conditions under which it has to work. It is supported on a specially reinforced superstructure, and when travelling the jib is lowered on to a bolster behind the cab of the lorry. The crane is driven by a power unit built up from a 24 h.p. Ford industrial type engine, fitted with an oversize tropical radiator and a Ferodo plate clutch for disengaging the engine when starting up or when the crane is not in use for short periods. The drive is taken from the engine through a triple roller chain running in an oil bath to the main shaft, and from there to the hoisting drum through machine-cut spur gearing driving a Ferodo-lined band clutch. An interesting feature of the hoisting mechanism is Neal's safety load-sustaining device, which makes the crane foolproof in operation and prevents any possibility of the load being accidentally dropped by an unskilled driver. The full circle slewing is controlled by Ferodo reversing clutches, as is also the derricking or luffing motion of the jib, which is transmitted through a worm gear drive with an automatic brake. The various motions are controlled from the driver's seat and the bank of levers which can be seen in the front of the crane.

A special safety load indicator is fitted to the jib of the crane, which not only indicates to the driver whether his load is within safe limits at any radius, but also rings an alarm bell if the safe working loads are exceeded. The crane sub-frame is fitted with screw jacks and special fittings arranged for relieving the lorry chassis of undue stresses when the crane is lifting across the frame. All the main castings are of steel and the gearing has machine-cut teeth, whilst the crane itself complies with the British Standard Institution specifications.

TWO-TON MOBILE CRANE

Electrical Thermal Storage Cookers.

Two new thermal storage electric cookers have been introduced by the General Electric Company, of Magnet House, Kingsway, W.C.2. One is an all storage cooker, which utilises stored heat for all the cooking operations. The other is a "semi-storage" cooker, which uses stored heat for hob cooking only. With a normal loading of 450 watts, which can be increased to 500 when the oven is used for roasting or baking, the all storage cooker has its heat for hob cooking stored in a block of cast iron weighing 165 lb., with its upper surface machined flat to serve as the hot plate. Below this block a smaller block weighing 75 lb. is fixed and holds a supply of heat at a sufficiently high temperature for grilling and oven heating. The entire heat input is fed into this lower block, which supplies the upper block by conduction across an air gap, a sheet of polished aluminium minimising the transfer by radiation. When heat is withdrawn from the upper block the temperature of the lower block is but little affected, with the result that for all practical purposes grilling and other cooking operations are independent of any previous cooking on the hob. Control of the heating elements is effected by a single rotary throw-over switch which connects either the block heating elements or the oven booster elements to the mains. Normally a polished reflector is kept in the oven below the under surface of the lower block and when it is removed radiant heat is available from the lower block for grilling or oven heating.

The semi-storage cooker has a higher maximum, but a lower average, load than the "all storage" model. Heat for hob cooking is stored in a cast iron block weighing 150 lb. The normal loading is 250 watts, but it can be increased to 500 during periods of heavy duty or reduced to 125 when the cooker is out of use for a day or two. The

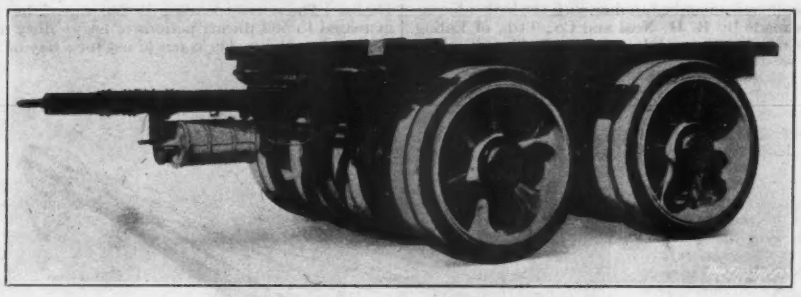
block into which the energy is fed is thermally insulated from the oven. Situated at the top of the oven the grill is loaded to 1500 watts. The oven is preheated by two bottom elements, together with half the grill. Two bottom elements provide the oven maintaining load of 600 watts. All the heating elements are under the control of a four-position rotary switch. Position (1), "normal," gives block heating elements only; (2), "grill," two grill elements, consuming 1500 watts; (3), "oven on full," one grill element and two oven bottom elements with a total consumption of 1950 watts; and (4), "oven low," one bottom element only, consuming 600 watts. The maximum load of the cooker is thus 1950 watts.

While the energy consumption of the all storage cooker is just under 11 units per day, or 3980 units per annum, that of the "semi-storage" cooker is 7½ units a day, or 2740 units per annum. Both these consumptions are greater than those of standard cookers, but the loss in this direction is in most cases more than compensated by the saving in maximum demand and distribution costs.

A 40-Ton Road Bogie.

In our issue of August 9th of this year we described a road vehicle specially constructed by R. A. Dyson and Co., Ltd., of 76–80, Grafton-street, Liverpool, for carrying boilers and heavy machinery up to the extent of 65 tons and are now able to illustrate another method of meeting much the same problem, devised by the same firm. In this case the order came from Messrs. Isaac Barrie, of 32, Midland-street, Glasgow, who have a large and regular volume of business in the way of transporting heavy girders, boilers, &c. In the previous case just mentioned, the load is entirely carried on a trailer, but in the one which we now illustrate loads up to about 40 tons are shared by a tractor and a separate bogie. The front end of the boiler, for instance, is supported on a turntable at the rear of a Scammell tractor lorry, and the major part of the load is carried by the Dyson bogie. The bogie is so adjusted that only the minimum amount of weight necessary for adhesion is imposed upon the tractor, and the major part carried by the bogie's multiple wheels. The outfit thus, in effect, becomes an articulated vehicle and can be handled very easily. By suitable positioning of the rear bogie, it can be made to track fairly accurately with the towing vehicle, so that cutting in on corners is avoided. The outfit can also be backed with certainty. This ease of handling greatly adds to the "safety" of the outfit.

65-Ton Lorry and Bogie Carrying Boiler



40-Ton Road Bogie

As will be seen from the illustrations, the bogie is of the eight-wheeled type, each wheel being fitted with twin 770 mm. by 140 mm. solid tires. The wheels are mounted in pairs on short axles carried on Woodhead trunnion-ended springs, so that each axle can oscillate and allow the wheels to adapt themselves to road camber and other irregularities. In addition, the springs on each side are connected by a balance beam rocking in a pressed steel housing. By these means proper distribution of the load is obtained over each pair of axles, and the oscillation of the axles themselves ensures the distribution of the load over each wheel. This is an extremely important point, as with some heavy machinery outfits it is often possible for one wheel to be very greatly overloaded, causing damage to both road surface and the tires.

The bogie frame has three steel channel cross members, to which can be bolted temporary wooden bolsters to fit the configuration of the load to be moved. It is then set in place and lashed to the load, so that the load forms the backbone of the outfit. The bogie has, however, a drawbar for use when it alone is to be moved about, but this drawbar is just lashed up to the centre line when transporting a long load. The four rear wheels of the bogie are fitted with 20in. internal expanding brakes, which can be operated from the driver's seat through the intervention of twin Dewandre vacuum cylinders. The brakes can also be worked by hand wheels at the rear of the bogie.

Another rather unusual transport problem which has recently been undertaken by R. A. Dyson and Co. is that of the bulk delivery of beer for Messrs. Ind, Coope and Allsopp. In this case it was desired to have a set of trailers, each capable of carrying sixty barrels—that is to say, 2160 gallons of beer. The tank is of the glass-lined type, by the Enamelled Metal Products Corporation (1933), Ltd., of Leven, Fife, and together with its contents, &c., weighs rather over 13¼ tons.

Special lightweight construction was therefore adopted, and the chassis frame was constructed from Chromador steel, which has a higher tensile strength than ordinary rolled steel channel. This enabled lighter sections to be used for the chassis frame, and, coupled with the use of steel pressings for the rear carriage and tubular cross members, enabled the tare weight to be kept within the required limit. The trailers are of the six-wheeled type, equipped with 38in. by 9in. tires. The trailer has brakes on all four rear wheels, the actual brake lining area being more than 500 square inches. The brakes are applied by means of twin Clayton-Dewandre vacuum cylinders controlled by a valve in the cab of the tractor. The brakes are also capable of being applied mechanically by means of a wire cable. The superstructure of the trailers is so arranged that it and the tank can be readily detached to make the vehicle available for other purposes.

American Engineering News.

Pumping Stations in a Wet Tunnel.

An exceptional and interesting method of expediting work and preventing flooding in the construction of a long tunnel through wet ground is the provision of a pumping plant in a large sealed and water-tight chamber connected with the tunnel headings at the bottom of the shaft. The tunnel in question is to be 14 miles long, on the new 240-mile aqueduct for the water supply of Los Angeles, in California. There are two shafts, about 800ft. deep. Immense volumes of water are encountered, and twice the Potrero shaft has been filled to within 100ft. of the top. The serious delays and the prospects of further troubles led to the decision to build a large pump room with automatic control and no manual control, except from the surface. The chamber, at right angles to the heading, is 100ft. long, 19ft. wide, and 22ft. high. It is connected with the tunnel by a passage of the same height, but only 4½ft. wide, but separated from the chamber by a bulkhead having a water-tight door near the top, this door being capable of resisting the pressure due to an 800ft. head of water. The several pipe lines and electric conduits are embedded in the bulkhead. The seven pumps have individual suction and discharge lines, but the latter are led to four discharge pipes extending up the shaft. There are five pumps with a capacity of 2600 gallons per minute and two of 1000 gallons. All are four-stage horizontal centrifugal pumps, directly connected to motors of 700 h.p. for the larger and 300 h.p. for the smaller pumps. There is also a ventilating system with two fans driven by 30 h.p. motors. A vacuum pump provides for priming by hand, but priming would not be necessary in case of flooding. All pipe joints are welded, except at the pump connections. At the Cabazon shaft, there are four pumps of 2500 gallons capacity per minute, and two of 1000 gallons per minute. In June, 1935, when the pumping plants were completed, the flow pumped out of the Potrero shaft was about 4600 gallons per minute, and about 4200 gallons per minute at the Cabazon shaft.

Rotating Caissons for Foundation Work.

Sinking large wells for foundations in clay and soft ground by means of revolving cutter heads, followed by the dropping in of steel cylindrical shells to line the excavation, has been followed successfully in the deep foundations for a number of American buildings. A recent development of this process is to rotate the entire caisson and to fit its bottom edge with teeth so as to cut through rocks or boulders encountered in sinking. By this method nearly 120 caissons from 4ft. to 8ft. 6in. in diameter have been sunk to rock—through a sand and clay formation full of boulders—for the new post office at New York. They reach rock at 60ft. to 80ft. below sea level, or 80ft. to 100ft. below the street surface. While the caisson is being sunk the contained core is excavated by high-pressure water jets. The speed of sinking is from 12ft. to 20ft. per hour, depending upon the formation and the number of boulders. The steel shells are about ½in. thick, made up in lengths of 30ft. to 40ft., but with a ring about 3ft. deep at the bottom of the first length. The bottom of this ring is made as a cutting edge by forming it into teeth with a torch, alternate teeth being bent inward and outward so as to cut a kerf about an inch wide. For driving or rotating the shell there is a steel frame or tower about 75ft. high, like a substantial pile-driver, but sliding in it is a massive steel head with a revolving centre to which the top of the cylindrical shell is clamped. This steel head weighs about 10 tons. Its revolving centre is driven from an electric motor of 125 h.p. through worm gear reduction having a ratio of 220 to 1. If a shell should jam or stick, a thrust bearing can apply a force of about 70 tons. There is also another thrust bearing of 35 tons force by which a shell can be raised or pulled out if necessary. The rotary speed ranges from 3 to 12 r.p.m., according to the resistance, and is under control of the operator, who has before him an ammeter gauge. Ordinarily about 200 ampères is ample, but the current may run up to 400 ampères in hard ground.

Modernisation of a Rolling Mill.

A large American sheet rolling mill has recently been modernised and re-equipped in order to reduce production costs and also to compete with four-high continuous mills, as many orders at present are not large enough for economical production on a continuous mill. The new machinery includes a three-high roughing mill of a new type, indicating the trend towards three-high mills rather than the conventional two-high mill, the object being economy in operation by making heavier reductions. There are also two-high automatically controlled finishing mills, with full mechanical equipment of automatically operated tables and conveyors. In the roughing mill the top and bottom rolls are 32in. in diameter and are both driven. The 20in. middle roll is floating, and both it and the top roll are balanced to prevent slippage. The mill takes sheet bars 16in. wide, instead of the usual 12in., and reduces them to No. 16 gauge in five passes. It is proposed to increase the size of bars to 24in., and to reduce the rolling to three passes. With its rolls 56in. wide, the mill takes four pair of bars per minute, each pair getting two single passes and three matching passes. Power is supplied by an electric motor of 1600 h.p. The output is 1700 to 1800 pairs of bars—or about 80 tons—in an eight-hour shift. Other equipment includes a combined roughing and finishing mill, and two finishing mills, with shearing machines for shearing packs of sheets 20in. to 72in. wide. The bar furnaces, heated by natural gas, are 90ft. long, with a capacity of 12 tons per hour. Conveyors deliver the bars to the table in front of the roughing mill, and other conveyors take them from the farther side of the mill to the finishing furnaces, which are of the chain type, 80ft. long. A tube type of gas furnace is used for annealing to reduce the time and cost of treatment. A pickling machine and two scrubbing and drying units are connected to three cold-rolling mills, the galvanised plates being pickled, cleaned, dried, and cold rolled in one continuous operation.

Scientific Aids to Management.—The exhibition of scientific aids to industrial, commercial, and domestic management, arranged by the Department of Industrial Co-operation at the meeting of the British Association for the Advancement of Science at Norwich this year, has been transferred to British Industries House, Oxford-street, London, W.1, and will be open until November 6th. This exhibition includes many interesting models, charts, brochures, &c., from the various research societies and institutions interested in scientific management. Amongst the exhibitors are the Anti-noise League, British Standards Institution, Confederation of Management Associations, Conservatoire National des Arts et Métiers, Industrial Health Research Board, International Chamber of Commerce, International Committee for Scientific Management, International "Fixed Calendar" League, International Labour Office, London and Cambridge Economic Service, London School of Hygiene and Tropical Medicine, Management Library, Mundaneum Institute, National Institute of Industrial Psychology, Orthological Institute, and the Research Committee for Scientific Management in Domestic Work.

Markets, Notes and News.

The prices quoted herein relate to bulk quantities. Unless otherwise specified home trade quotations are delivered f.o.t. Export quotations are f.o.b. steamer. A comprehensive list of the prices of materials mentioned below will be found on the next page.

Higher Continental Steel Plate Prices.

One of the most interesting results of the meetings last week of the British and Continental steel makers was the decision to advance the price of Continental steel plates for the British market. The extent of the increase took the market by surprise, but it is suggested that British prices also may shortly be advanced. The quotation for Continental plates ¼in. and thicker was raised from £6 1s. 6d. to £6 4s.; ⅜in. from £6 1s. 6d. to £6 6s. 6d.; ½in. from £6 5s. 9d. to £6 8s. 3d. This movement makes Continental plates dearer than British for some deliveries. For instance, the price of Continental Thomas untested steel plates is now £8 10s. delivered Birmingham district, whilst the price for British Siemens-Martin steel plates is £8 2s. 6d. The quotation of Continental plates ⅜in. similar delivery, is rather less than for British ⅜in., being £8 13s. delivered against a price of £8 17s. 6d. Continental ½in. plates, however, would be £8 15s. delivered Birmingham, compared with the British price of £8 10s. For Continental plates delivered London the price will be roughly 1s. dearer than British. In Glasgow it will probably work out at about the same level, although in some of the Scottish districts it should be slightly cheaper than the British quotation. The British prices are calculated less the rebate of 15s. given to buyers using only British material. It is suggested that the Continental steel makers are rather indifferent to losing business to the British as a result of the arrangement as it is understood the latter have agreed to take any unsold balance of the quota. The division of the Continental steel coming into this country, however, has aroused some feeling. Apparently a number of merchants and consumers were promised a specific share of the Continental quota coming on the British market. It is alleged that in many cases they have received only a fraction of the quantities promised, and other firms having less claim on Continental works have received more favourable treatment. This has led to firms, which have hitherto held aloof from the British rebate scheme, showing some anxiety to become members. They would then be unable to use any other but British material, although they would be allowed to handle a small tonnage of foreign steel bars.

The Pig Iron Market.

The market for pig iron in all districts seems to be strengthening, and most consumers are under the impression that it will be necessary shortly to increase the number of furnaces now in operation. The producers, however, appear rather reluctant to take steps in this direction, and in some cases are inclined to adopt the view that the present make, plus the stocks, is about sufficient to meet the demand. On the North-East Coast business shows signs of expanding, but there is not much surplus pig iron available after deliveries against existing contracts have been made. It is anticipated that the requirements of the light castings foundries in Scotland will increase during the last two months of the year, and this will accentuate the present stringency. The demand from the local foundries also has broadened, and in some cases users complain that they cannot obtain enough iron against their running contracts to meet their requirements. Most of the local consumers, however, have covered their needs for some months ahead, but find a difficulty in securing supplementary tonnages. The producers are reluctant to sell beyond March, 1936, although quite a number of users would be prepared to contract beyond that date. In the Midlands the producers are carrying good order books, and have little iron left over when their contract deliveries are completed. Light castings makers are taking good quantities, and the improvement in business with the engineering industry, which made itself felt at the beginning of the quarter, continues to improve. The weak spot in the market is the poor demand for forge iron. Now and again a spurt in buying occurs, but hitherto these have been of short duration. In the Lancashire district new business has been on a rather more extensive scale than for the past week or two, but most consumers have covered their probable needs up till March of next year. Steady conditions have ruled in the Scottish market, and practically all the make appears to be passing into consumption. In the hematite market a fair amount of new business has been entered into, probably because rumours have been current that an upward movement in prices may take place. Stocks are comparatively low in all districts, and deliveries against contracts are reported to be sufficient to absorb the current production.

The Midlands and South Wales.

Usually, the prospect of a General Election has a disturbing influence upon business, but so far the Midland steel trade seems to be unaffected by the approaching contest. The demand in practically all branches has strengthened steadily since the end of September, and in some departments consumers' requirements are taxing the capacity of the producing works. This is particularly noticeable in the semi-finished steel department, and complaints are frequently heard from consumers of delays in the receipt of material and the difficulty of placing orders for reasonably near delivery. It is reported that the British steel makers have arranged for Continental suppliers to anticipate some deliveries against the forthcoming quota. In the ordinary way these shipments would not have commenced until November, but their acceleration does not appear to have eased the situation to any appreciable extent. A number of the Midland producers are unable to accept fresh business, as they have sold their production for months ahead. The re-rollers are working almost at capacity, and naturally the position with regard to the supply of their raw materials in the shape of billets is causing anxiety. Business in strip has been on an active scale and the official quotation of £9 7s. is adhered to. An interesting change has occurred in the position of the market for small steel bars. A kind of "gentleman's agreement" has been arrived at by the associated firms and the principal outsider by which the prices have been advanced 10s. per ton to £8 5s. d/d London and £8 d/d in the provinces. Considerable pressure is being exerted by constructional engineers to obtain deliveries of joists and sections, and in some cases suppliers are falling into arrears with their deliveries. There has been a slight lull in the demand for steel sheets following upon the recent price advance; but as many consumers anticipated the movement and covered themselves, this is not surprising. Special sheets for the motor industry have been bought on an improved scale of late, and the tendency is for business to expand in this direction. New business in colliery steel has been quiet, but most of the collieries have covered their requirements far forward. Business in plates has been moderate, but is expected to improve as a result of the new arrangement by which the price of Continental plates has been advanced. In South Wales the steel works are busy, but the tin-plate mills under the restriction scheme are operating at just over 56 per cent. of capacity. The demand for structural steel is on a good scale, and there is considerable pressure to obtain delivery.

The North-East Coast and Yorkshire.

The situation on the North-East Coast is exceptionally favourable to the producers, who, without exception are better employed than at any time this year. Naturally, the outlook is somewhat clouded by the approach of the General Election, but the manufacturers will not be perturbed by a relaxation in the persistent pressure for supplies they have experienced for the past few months. In the semi-finished steel section the producers of billets would probably welcome a halt in the demand which would enable them to overtake some of their arrears. Lately there has been an expansion in consumers' requirements of sheet bars, but the pressure is chiefly for billets of untested steel to meet the deficiency created by the reduction in the imports of Continental material. Consumers continue to complain of the difficulty of obtaining delivery, and some makers will not accept orders for execution before the early part of next year. The price position in this department has strengthened, and whilst the official quotation for soft untested billets is unaltered at £5 10s. for 500-ton lots, 100 tons of a size, the price most consumers have to pay is nearer £6. The constructional engineering shops on the North-East Coast are busy, and this ensures a strong demand for joists and sections. The mills producing this material are making heavy deliveries and carry sufficient orders on their books to maintain the present rate of output for several months to come. Following a period during which orders for rails came to hand somewhat slowly, more active conditions have developed in this branch, and lately contracts for tramway rails totalling about 6000 tons have been placed with works in this district. The plate mills are fairly well employed, and soon the recent orders for ships should be reflected in heavier outputs. It is also suggested that the increase in the prices of Continental plates for the British market by agreement with the British steel makers should result in the home works obtaining a larger share of the general trade in this description of steel. In the Yorkshire steel industry the recent high rate of activity has been maintained. The demand for basic billets shows no signs of shrinking, and in the Sheffield district a record number of furnaces are in operation. The market requirements of acid billets also has improved. In the finished steel department there is a strong demand for strip and a large tonnage of steel bars is being turned out at the re-rolling works. Business in high-speed steel has been only moderate, but some good orders have been received for alloy steel from the motor trades.

Current Business.

A contract valued at £7500 for the supply of pipes to the Santa Marta Waterworks, Colombia, has been obtained by the Staveley Coal and Iron Company, Ltd. An order for a refrigerator motor ship of 11,000 tons has been placed with Cammell Laird, Ltd., Birkenhead, by the Blue Star Line, Ltd. A new plant for the manufacture of Adamite steel rolls has been put into operation at the Whifflet Foundry of R. B. Tennant, Ltd., at Coatbridge. The Forges de Clabecq have placed a contract for their requirements for refractory materials for a new plant, which includes a strip mill, reheating furnaces, and soaking pits, with General Refractories, Ltd. Orders have been placed by the London Passenger Transport Board for 3000 tons of tram rails with the Skinningrove Iron Company, Ltd., and for 2675 tons with Dorman, Long and Co., Ltd. J. Hay and Sons, Ltd., Glasgow, have ordered from the Ailsa Shipbuilding Company, Ltd., Troon, a steamer of 1200 tons d.w. Lithgows, Ltd., of Port Glasgow, have received an order from the Broken Hill Proprietary Company, Ltd., of Australia, for two oil-carrying steamers, each having a weight carrying capacity of 7900 tons. The Clydesdale Stamping Company, Ltd., has obtained a contract for hot stampings of the value of about £25,000. With the work in hand this contract will keep the company busy until July, 1936. By Order of the Court the sale has been confirmed of the assets of Marshall, Sons and Co., Ltd., of Gainsborough, Lincs., to Thos. W. Ward Ltd., of Sheffield. The sale includes the Britannia Works, the Carr House and Trent Works. The well-known business of Marshall and Sons was founded in 1848 and expanded until the concern represented a value considerably over one million pounds in paid-up capital and debentures. Its manufactures include tea machinery, road rollers, stationary engines and agricultural machinery generally. The company owns interests in subsidiary firms, the principal one being Marshalls (India) Ltd., of Calcutta. Even before the war it employed 4000 hands, and at the present time some 930 workmen are engaged. The position is being reviewed by the new owners with the object, if possible, of continuing the industry at Gainsborough, The Department of Overseas Trade announces that the following contracts are open for tender:—Egyptian Ministry of Communications: One double-ended punching and shearing machine; one panel planing and thicknessing machine, one automatic grinding machine for planer knives; two self-acting, sliding, surfacing, and screw-cutting high-speed lathes of powerful construction and modern design, and 13in. sensitive drilling machines (Alexandria, December 9th). South African Railways and Harbours Administration: Supply of a new 3500 tons bow-well, twin-screw suction hopper dredger for East London (Johannesburg, December 17th); heavy section rail motor trollies (South Africa, November 18th). New Zealand, Public Works Department: Motor-driven, vertical-shaft centrifugal pump (Wellington, December 10th). Sydney, Conservation and Irrigation Commission: Supply, delivery, and erection of a water-tube type steam boiler with accessories for the Yanco power-house (Australia, December 16th).

Copper and Tin.

Rather quiet conditions rule in the electrolytic copper market and consumers, now that the international situation seems to have improved, are less inclined to lay in stocks. Buying during the first half of this month was on a particularly heavy scale, and it is anticipated that the statistics at the end of October will show a further reduction in the stocks both in America and Europe. The possibility of there being a considerable demand for some time to come for armament purposes has not escaped the attention of the market, and this, with the steady development of industrial requirements all over the world, is regarded as assuring improving conditions once the present political uncertainties are removed. Business in electrolytic copper in the United States has been restricted of late, and it is suggested that some consumers bought more copper than they required in the early part of the month and may be tempted to resell part of it. This, of course, might create easier market conditions for a time. Prices in the London standard market have fluctuated, largely as a result of spasmodic liquidation. At the beginning of this week there were considerable offerings and the price dropped rather sharply. Later, however, a firmer tendency developed. . . . Whatever may be said of the effects of the International Tin Control, it cannot be argued that it has fulfilled the promise given at the inception of the scheme that it would stabilise values. At the moment the market seems to be in a somewhat nervous condition and to be waiting until the position resulting from the recent increase in the quota is more clearly defined. The general view seems to be that the statistics at the end of this month will show an increase in the visible supply of from 1000 to 1500 tons. There has been a considerable amount of selling, some of which, no doubt, was on speculative account, and prices have fallen sharply. At the beginning of this week cash tin, which not long ago was quoted at £247 10s., and has been gradually declining, slipped back a further £6 to £221. The backwardation, however, remains at about £8, and this indicates that there is still no surplus of prompt metal. According to figures given in the Bulletin of the International Tin Research and Development Council published by The Hague Statistical Office, the American consumption for the year ended August 31st last was 54,160 tons, an increase over the previous year's total of 11·9 per cent., whilst the British consumption was 21,025 tons, a decline of 1 per cent. The Italian consumption of tin was 5362 tons, an increase of 34·4 per cent.

Lead and Spelter.

Price movements in the lead market have been somewhat uncertain and the tendency has been for easier conditions to develop. At the beginning of this week values receded on rather heavy selling, and it seems evident that speculative interest in this market is evaporating, probably because it is realised that the demand for armament purposes is not likely to be so heavy as was at first expected. It is possible also that some consumers bought rather more metal than they required as a result of the uncertain political outlook and as a consequence have re-sold some of their holdings. The position, however, appears to be intrinsically sound. The consuming industries are meeting with a heavy demand for their products, so that the check to buying for industrial purposes is likely to be only temporary. Now that the strike at the Mexican smelter is over supplies from that quarter are expected to reach the London market at the end of November or the beginning of December. The arrivals of Empire lead are not more than normal and leave little surplus for sale on the open market, as most of it has been booked by users before its arrival. . . . Movements in the spelter market have in most cases followed the fluctuations in the lead price. The general view, however, seems to be that the position of this market is steadily improving and that consumption is likely to broaden. A feature of the demand has been the increase in the requirements of the die castings industry, which is meeting with a strong request for its products from the motor car manufacturers. The recent improvement in the sales of galvanised sheets has also been reflected in larger purchases of spelter. Supplies are on an average scale and fair shipments are expected to reach this country at the end of the month from Belgium.

Current Prices for Metals and Fuels.

Makers' official home trade prices per ton, delivered buyers' stations. Sections, joists and plates are subject to a rebate to home users purchasing only from associated British Steelmakers: joists, 22s. 6d.; plates and sections, 15s. Export orders of 250 tons and over may be subject to special quotations.

PIG IRON.

	Home.	Export.
	(*D/d Teesside Area*)	
N.E. Coast—	£ s. d.	£ s. d.
Hematite Mixed Nos.	3 10 6	3 2 0
No. 1	3 11 0	3 3 6
Cleveland—	(*D/d Teesside Area*)	
No. 1	3 10 0	3 4 0
No. 3 G.M.B.	3 7 6	3 1 6
No. 4 Forge	3 6 6	3 0 6
Basic (*Less 5/- rebate*)	3 10 0	—
Midlands—		
Staffs.—	(*Delivered to Black Country Station*)	
North Staffs. Foundry	3 11 0	—
„ „ Forge	3 6 6	—
Basic (*Less 5/- rebate*)	3 15 0	—
Northampton—		
Foundry No. 3	3 7 6	—
Forge	3 2 6	—
Derbyshire—		
No. 3 Foundry	3 11 0	—
Forge	3 6 0	—
Scotland—		
Hematite, f.o.t. furnaces	3 13 6	—
No. 1 Foundry, ditto	3 12 6	—
No. 3 Foundry, ditto	3 10 0	—
Basic, d/d (*Less 5/- rebate*)	3 10 0	—
N.W. Coast—	3 14 0	d/d Glasgow
Hematite Mixed Nos.	3 18 6	„ Sheffield
	4 4 6	„ Birmingham

MANUFACTURED IRON.

	Home.	Export.
Lancs.—	£ s. d.	£ s. d.
Crown Bars	9 12 6	—
Best Bars	10 2 6	—
S. Yorks.—		
Crown Bars	9 12 6	—
Best Bars	10 2 6	—
Midlands—		
Crown Bars	9 15 0	—
Marked Bars (Staffs.)	12 0 0	—
No. 3 quality	7 10 0	—
No. 4 „	8 0 0	—
Scotland—		
Crown Bars	9 12 6	9 5 0
Best	10 2 6	9 15 0
N.E. Coast—		
Common Bars	9 12 6	8 15 0
Best Bars	10 2 6	9 15 0
Double Best Bars	10 12 6	10 0 0

STEEL.

London and the South—	Home.	Export.
	£ s. d.	£ s. d.
Angles	8 10 0	7 7 6
Tees	9 10 0	8 7 6
Joists	8 17 6	7 7 6
Channels	8 15 6	7 12 6
Rounds, 3in. and up	9 10 0	8 7 6
„ under 3in.	8 14 6	7 0 0
Flats, 5in. and under	8 14 6	7 0 0
Plates, ¼in. (basis)	9 0 0	7 15 0
„ 5/16in.	9 5 0	8 0 0
„ ⅜in.	9 10 0	8 5 0
„ 7/16in.	9 15 0	8 10 0
„ ½in.	9 10 0	8 5 0
North-East Coast—	£ s. d.	£ s. d.
Angles	8 7 6	7 7 6
Tees	9 7 6	8 7 6
Joists	8 15 0	7 7 6
Channels	8 12 6	7 12 6
Rounds, 3in. and up	9 7 6	8 7 6
„ under 3in.	8 12 0	7 10 0
Plates, ¼in.	8 15 0	7 15 0
„ 5/16in.	9 0 0	8 0 0
„ ⅜in.	9 5 0	8 5 0
„ 7/16in.	9 10 0	8 10 0
„ ½in.	9 5 0	8 5 0
Boiler Plates, ¼in.	9 5 0	—
Midlands, and Leeds and District—	£ s. d.	£ s. d.
Angles	8 7 6	7 7 6
Tees	9 7 6	8 7 6
Joists	8 15 0	7 7 6
Channels	8 12 6	7 12 6
Rounds, 3in. and up	9 7 6	8 7 6
„ under 3in.	8 12 0	7 10 0
Flats, 5in. and under	8 12 0	8 17 6
Plates, ¼in. (basis)	8 17 6	7 15 0
„ 5/16in.	9 2 6	8 0 0
„ ⅜in.	9 7 6	8 5 0
„ 7/16in.	9 12 6	8 10 0
„ ½in.	9 10 0	8 5 0
Boiler Plates, ¼in.	9 7 6	7 15 0

STEEL (*continued*).

Glasgow and District—	Home.	Export.
	£ s. d.	£ s. d.
Angles	8 7 6	7 7 6
Tees	9 7 6	8 7 6
Joists	8 15 0	7 7 6
Channels	8 12 6	7 12 6
Rounds, 3in. and up	9 7 6	8 7 6
„ under 3in.	8 12 0	7 10 0
Flats, 5in. and under	8 12 0	8 17 6
Plates, ¼in. (basis)	8 15 0	7 15 0
„ 5/16in.	9 0 0	8 0 0
„ ⅜in.	9 5 0	8 5 0
„ 7/16in.	9 10 0	8 10 0
„ ½in.	9 5 0	8 5 0
Boiler Plates	9 5 0	—
South Wales Area—	£ s. d.	£ s. d.
Angles	8 7 6	7 7 6
Tees	9 7 6	8 7 6
Joists	8 15 0	7 7 0
Channels	8 12 6	7 12 6
Rounds, 3in. and up	9 7 6	8 7 6
„ under 3in.	8 12 0	7 10 0
Flats, 5in. and under	8 12 0	8 17 6
Plates, ¼in. (basis)	8 17 6	7 15 0
„ 5/16in.	9 2 6	8 0 0
„ ⅜in.	9 7 6	8 5 0
„ 7/16in.	9 12 6	8 10 0
„ ½in.	9 10 0	8 5 0

Ireland—	Belfast.	Rest of Ireland.
	£ s. d.	£ s. d.
Angles	8 12 6	8 15 0
Tees	9 12 6	9 15 0
Joists	9 0 0	9 2 6
Channels	8 17 6	9 0 0
Rounds, 3in. and up	9 12 6	9 15 0
„ under 3in.	9 2 0	9 4 6
Plates, ¼in. (basis)	9 0 0	9 2 6
„ 5/16in.	9 5 0	9 7 6
„ ⅜in.	9 10 0	9 12 6
„ 7/16in.	9 15 0	9 17 6
„ ½in.	9 12 6	9 15 0

OTHER STEEL MATERIALS.

Sheets.	Home.	Export.
	£ s. d.	£ s. d.
10-G to 13-G., f.o.r.	9 15 0	9 0 0
14-G. to 20-G., d/d	11 0 0	9 5 0
21-G. to 24-G., d/d	11 5 0	9 10 0
25-G. to 27-G., d/d	11 17 6	10 2 6

The above home trade prices are for 4-ton lots and over; 2-ton to 4-ton lots, 10s. per ton extra; and under 2-ton lots, 30s. per ton extra.

Galvanised Corrugated Sheets, Basis 24-G.

Home.	£ s. d.
4-ton lots and up	13 5 0
2-ton to 4-ton lots	13 12 6
Under 2 tons	15 5 0

Export: £12 15s. 0d., c.i.f. India.
„ £11 10s. 0d., f.o.b. other markets.
„ Scandinavian Markets free.

Tin-plates.
20 by 14 basis, f.o.b. Bristol Channel Ports, 18/9.
Tin-plate Bars, d/d South Wales Works, £5 5s. 0d.

Billets.	£ s. d.
Basic (0·33% to 0·41% C.)	6 12 6
„ Medium (0·42% to 0·60% C.)	7 2 6
„ Hard (0·61% to 0·85% C.)	7 12 6
„ „ (0·86% to 0·99% C.)	8 2 6
„ „ (1% C. and up)	8 12 6
Soft (up to 0·25% C.), 500 tons and up	5 10 0
100 to 250 tons	5 17 6
Rails, Heavy, 500-ton lots, f.o.t.	8 10 0
„ Light, f.o.t.	7 10 0

FERRO ALLOYS

	Per Ton.	Per Unit.
Tungsten Metal Powder	3/3 per lb.	
Ferro Tungsten	3/- per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£21 15 0	7/-
„ „ 6 p.c. to 8 p.c.	£21 0 0	7/-
„ „ 8 p.c. to 10 p.c.	£21 0 0	7/-
„ „ Specially Refined		
„ „ Max. 2 p.c. carbon	£34 0 0	11/-
„ „ „ 1 p.c. carbon	£36 5 0	11/-
„ „ „ 0·50 p.c. carbon	£37 5 0	12/-
„ „ „ carbon free	9½d. per lb.	
Metallic Chromium	2/5 per lb.	
Ferro Manganese (loose) 76 p.c.	£10 15 0 home	
„ Silicon, 45 p.c. to 50 p.c.	£12 15 0 scale 5/- p.u.	
„ „ 75 p.c.	£17 17 6 scale 6/- p.u.	
„ Vanadium	12/8 per lb.	
„ Molybdenum	4/6 per lb.	
„ Titanium (carbon free)	9d. per lb.	
Nickel (per ton)	£200 to £205	
Cobalt	5/6 per lb.	

NON-FERROUS METALS.

Official Prices, October 30th.

Copper—	
Cash	£34 16 3 to £34 17 6
Three months	£35 3 9 to £35 5 0
Electrolytic	£39 5 0 to £39 15 0
Best Selected Ingots, d/d Birmingham	£39 10 0
Sheets, Hot Rolled	£68 0 0

	Home.	Export.
Tubes, Solid Drawn (basis)	10½d.	10½d.
„ Brazed (basis)	10½d.	10½d.
Brass—		
Ingots, 70/30, d/d Birmingham	£33 0 0 to £34 0 0	
	Home.	Export.
Tubes, Solid Drawn, 2/1 Alloy	9½d.	9½d.
„ Brazed	11¾d.	11¾d.
Tin—		
Cash	£217 15 0 to £218 0 0	
Three months	£211 5 0 to £211 10 0	
Lead: Cash and forward	£17 7 6	
Spelter: Cash and forward	£16 5 0	
Aluminium Ingots (British)	£100	

FUELS.

SCOTLAND.

Lanarkshire—	Export.
(f.o.b. Grangemouth)—Navigation Unscreened	13/3 to 13/6
Hamilton Ell	15/-
Navigation Splints	17/6
Ayrshire—	
(f.o.b. Ports)—Steam	12/9 to 13/-
Fifeshire—	
(f.o.b. Methil or Burntisland)—	
Prime Steam	14/6
Unscreened Navigation	12/9 to 13/-
Lothians—	
(f.o.b. Leith)—Hartley Prime	13/6 to 14/6
Secondary Steam	12/6 to 13/-

ENGLAND.

Yorkshire, Manchester—	
B.S.Y. Hard Steams	18/6 to 21/6
Furnace Coke	14/6 to 17/6
Northumberland, Newcastle—	
Blyth Best	15/- to 15/6
„ Second	13/9 to 14/-
„ Best Small	10/6 to 11/-
Unscreened	12/6 to 13/6
Durham—	
Best Gas	14/8
Foundry Coke	19/- to 20/-

Sheffield—	Inland.
Best Hand-picked Branch	23/- to 24/- —
South Yorkshire Best	20/- to 22/- —
South Yorkshire Seconds	17/- to 18/6 —
Rough Slacks	8/- to 9/- —
Nutty Slacks	7/- to 8/6 —

SOUTH WALES.

Cardiff—	
Steam Coals:	
Best Admiralty Large	19/6
Best Seconds	19/- to 19/4½
Best Dry Large	18/9 to 19/3
Ordinaries	18/3 to 18/6
Bunker Smalls	12/6 to 13/6
Cargo Smalls	11/6 to 12/6
Dry Nuts	22/- to 26/-
Foundry Coke	27/- to 40/-
Furnace Coke	19/- to 22/6
Patent Fuel	21/-
Swansea—	
Anthracite Coals:	
Best Large	36/- to 40/-
Machine-made Cobbles	41/- to 48/6
Nuts	40/- to 48/6
Beans	25/- to 30/-
Peas	19/- to 23/-
Rubbly Culm	11/6 to 12/-
Steam Coals:	
Large Ordinary	18/- to 20/6

FUEL OIL.

Inland consumption; contracts in bulk.
Exclusive of Government tax of 1d. per gallon.

Ex Ocean Installation.	Per Gallon.
Furnace Oil (0·950 gravity)	3½d.
Diesel Oil	4d.

French Engineering Notes.

(From our own Correspondent in Paris.)

Metallurgical Congress.

THE International Congress on Mines, Metallurgy and Applied Geology, held in Paris last week, enabled Monsieur H. Le Chatelier, at the inaugural meeting in the Sorbonne, to make a brief survey of the progress of metallurgy during the long period that has elapsed since Paris was previously selected for the Congress in 1900. That survey provided the keynote to the subsequent sittings of the metallurgical section in the Ecole Centrale des Arts et Manufactures, where about 120 papers were presented. While official communications gave accounts of present achievements in different countries, individual papers dealt mainly with research work that affected the future of metallurgical science. The character of the communications and the discussions thereon denoted an accelerated advance in research which gave promise of industry benefiting more actively in the early future from the results of that work. Following upon papers on special steels, to which Sir Robert Hadfield made an important contribution, there were discussions during which Dr. Benedicks, of Stockholm, declared that there was nothing mysterious in the effects of additions of foreign elements to steel, and implied that the elimination of mystery by research had placed the problem of special steels on an essentially practical plane. Two papers on the formation of flakes in special steels, one by Professor L. Guillet and Monsieur Ballay, were followed by a discussion upon whether flakes in the steel structure were produced by tension through rapid cooling or by the occlusion of hydrogen. The latter hypothesis was generally accepted as being borne out by experience, particularly by the fact that it is possible to increase considerably the size of flakes in steel heated in ovens with coal gas. It was noted that the steel structure is not so susceptible to hair cracks in the presence of flakes. The increasing list of special steels also raised the question of nomenclature by means of appellations that should offer a sufficient international concordance to avoid possibility of confusion. It was decided to recommend the appointment of a committee to prepare a list of names for special steels that would correspond to foreign nomenclatures. In the same way, communications in the foundry section stressed the importance of establishing a classification which is more needed now that so many special castings are produced. That the field for special iron castings will be widened by the electric furnace was the conclusion reached by Monsieur Le Thomas, who is one of the protagonists of electric smelting. The electric furnace, he said, was employed for definite purposes, produced a steel possessing high mechanical properties, and eliminated defects. Its future depended upon the cost of electricity, and its progress was therefore particularly marked in countries having large resources of hydro-electric energy. A new method of centrifuging cast iron now being experimented with at the Cockerill works was described by Monsieur Vroonen. The apparatus has a longitudinal conical section inclined to the smaller end. The molten metal passes through three phases: first a turbulence in the large upper diameter, then a separation of the lighter products in the medium section, and finally a coalescence of impurities, which are removed from the bath on leaving the apparatus. It is claimed that this process doubles the mechanical resistance of cast iron. Most of the papers were of a special character and some purely mathematical, notably that of Monsieur Derclaye providing formulæ for the designing of Cowper ovens and showing that little, if anything, had been achieved by efforts to improve upon the standard pattern.

Coal Distillation.

The mining section of the Congress held its sittings in the Conservatoire des Arts et Métiers, and a subject of particular interest to this country was the utilisation of the small coal, which reaches percentages of 50 and even up to 80 in some collieries. Small coal is employed mainly for the manufacture of patent fuels, and artificial anthracite, in addition to its distillation into semi-coke, which would offer great possibilities if it could be sold at profitable prices. Five years ago the home peak production of coke was 9·3 million tons, and of that total 7·5 million tons contained coke from agglomerated small coal. The consumption of coke was then 14 million tons. When the slump began efforts were made to find an outlet amongst domestic users for coke, semi-coke, and artificial anthracite in place of imported fuels, but coke failed for central heating on account of the difficulty of regulating furnace temperatures and because of the formation of clinkers, and the use of semi-coke was restricted by the cost. How best to treat coal is therefore a serious problem for the colliery companies which pinned their faith in low-temperature carbonisation, and while good results have been achieved the commercial value of the coke and by-products has fallen considerably through the difficulty of disposing of them. Probably nowhere has more been done to solve the problem of making use of coal of low intrinsic value at the pits than at the French collieries, and the chief aim has been to produce internal combustion engine fuels, which is admittedly out of the question when the cost is so high that nothing can be done without an exaggerated fiscal protection. The hydrogenation process has always been regarded as of doubtful application to French coal, and the first cost of installation, at any rate, relegated it to the background pending a fuller knowledge of its practical and economic character; but at the Congress the necessity of making the best use of coal brought the hydrogenation process into greater prominence, at the same time that a fuller investigation was made into a more economical development of low-temperature carbonisation. The French Government is particularly interested in the home production of fuels for small internal combustion engines, and the future of the hydrogenation process in this country depends upon what the State can do to finance it. Money has been allocated from the public works relief fund for the installation of an hydrogenation plant in the Pas de Calais, so that there is a prospect of an early start being made to ascertain whether this method of treating coal is really applicable to fuel produced over a large area of the French coalfield.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., 1s. each.

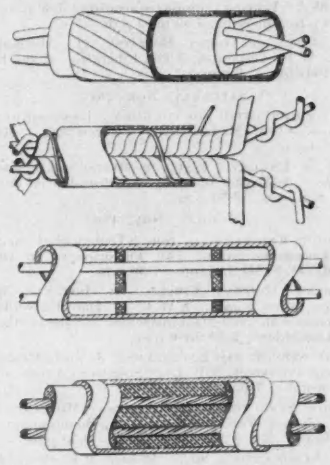
The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

ELECTRICAL APPLIANCES.

435,131. March 16th, 1934.—HIGH-FREQUENCY ELECTRIC TRANSMISSION CIRCUITS, *Standard Telephones and Cables, Ltd., Connaught House, 63, Aldwych, London, W.C.2.*

This invention relates to electrical transmission circuits and is concerned especially with circuits comprising a pair of conductors surrounded by an individual shield. A particular object of this invention is to obtain a transmission circuit which has the properties of low attenuation and substantial freedom from interference throughout a wide range of frequencies. Another object of the invention is to obtain a circuit of such characteristics which is balanced with respect to ground. For really wide frequency bands, for example, of the order of 100 to 500 kc., optimum proportioning of the conductors, the conductor spacing and the diameter of the shield become important for minimum attenuation and in accordance with the invention there is provided a high-frequency electrical transmission circuit comprising a pair of conductors enclosed in a conducting shield and insulated from the shield and from one another, wherein for a

No 435,131



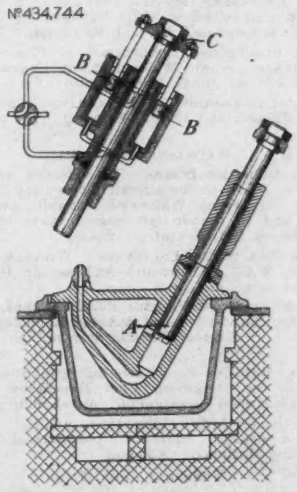
shield of circular cross section the ratio of the inter-axial spacing of the conductors to the inner diameter of the shield is approximately 0·40–0·46, and the ratio of the inner diameter of the shield to the diameter of each conductor is approximately 5·0–5·4, whereas for a shield of approximately oval cross section consisting of two semi-circular ends joined by straight portions, the ratio of the inter-axial separation of the conductors to the inner diameter of the semi-circular portion of the shield plus the length of either flat portion thereof is approximately 0·42–0·46 and the ratio of the inner diameter of the semi-circular portion of shield to the diameter of each conductor is approximately 3·3–3·7. Since the shielding effect of such an enclosing shield decreases as the frequency decreases, it is proposed to twist the conductors of the pair helically around the axis of the shield or otherwise transpose them in order to annul any interference which may pass through the shield at low frequencies. The illustrations show several alternative forms of construction.—*September 16th, 1935.*

MACHINE TOOLS AND SHOP APPLIANCES.

434,744. April 11th, 1934.—DIE-CASTING MACHINES, Elektronmetall Gesellschaft mit beschränkter, Haftung, Cannstatt, Stuttgart, Germany.

In hydraulically operated die-casting machines, the plunger A of the pump sometimes seizes and cannot be withdrawn without the dismantling of a considerable part of the machine.

No 434,744



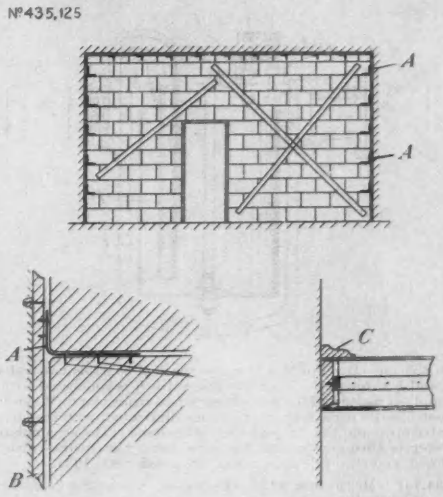
As a consequence, the makers, instead of arranging the pump plunger A and the hydraulic ram in line, use two rams B B side by side, connected with the plunger by a yoke C. The arrangement has the advantages of providing a greater ram area for pulling out a seized plunger, while it is necessary only to remove the yoke to expose the plunger.—*September 9th, 1935.*

BUILDING.

435,125. March 16th, 1934.—UNIT WALL CONSTRUCTION, V. Lefebure and A. H. Douglas, Imperial Chemical House, Millbank, London, S.W.1, and Imperial Chemical Industries, Ltd.

This invention is concerned with the partition walls of buildings and aims at providing an easily erected wall with optimum sound-proof qualities. The wall itself is built up of "units," such as coke breeze blocks, and is attached to the surrounding

No 435,125



structure by means of angle brackets A made of hoop iron. These brackets are nailed to battens B secured to the main structure and are also nailed to, or embedded in, the blockwork of the wall. It is essential that the wall does not bear against the main structure and is held in place only by the brackets. The gap between the two may be obscured by a moulding strip C.—*September 16th, 1935.*

WATER PURIFICATION.

434,695. March 26th, 1935.—CLARIFYING TANKS, Karel Lambertus Hagemans, Haarlemmerweg No. 16, Leiden, Holland, and N. V. Machinenfabriek Reineveld, Haagweg 126, Delft, Holland.

This is a clarification tank for water which has already been mixed with purifying ingredients. The raw water, mixed with the chemicals, is introduced at A and flows over the weir B into the central tube C. It escapes by the radial passages D into the

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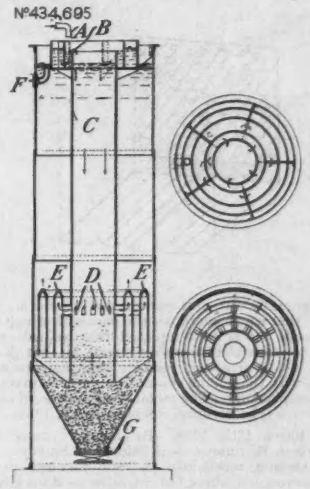

two annuli E E. Then, flowing upward through slots in the top of these passages, it is discharged by the branch F. In the passage the impurities, as a sludge, gravitate out and are occasionally discharged through the valve G. It is stipulated that the passages D and E should have "roof-shaped" tops to prevent the lodgment of sludge, and it is suggested that if the passages E are 100 mm. wide the slots in their tops should be 4 mm. and 3 mm. wide respectively.—*September 6th, 1935.*

MISCELLANEOUS.

434,352. May 2nd, 1934.—FROTH FLOTATION PROCESSES, T. J. Taplin, 6, Walpole-gardens, Strawberry Hill, Middlesex.

The inventor claims that the efficiency of a froth flotation

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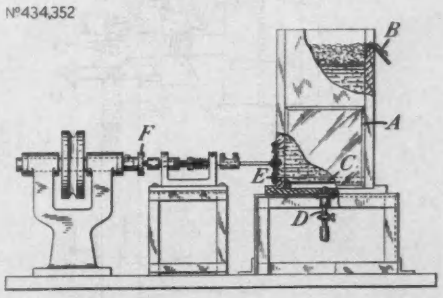

system of concentrating ores may be increased by subjecting the pulp of ore suspended in water to a rapid pulsation. The drawing shows the chamber A, in which the separation takes place, with an ore overflow B. This chamber has a porous bottom C, through which air is bubbled up from the supply

pipe D. In the side of the chamber there is the rubber diaphragm E, which is vibrated at the rate of about 300 cycles per second by the cam mechanism F.—*August 30th*, 1935.

434,688. March 8th, 1935.—STEAM TRAPS, Holden and Brooke, Ltd., Sirius Works, West Gorton, Manchester, and D. G. McNair.

This is a low-pressure trap with a positive discharge. The inlet is shown at A and the outlet at B. Both have check valves. The condensate accumulates in the casing until it overflows into the inverted bell C, and is subsequently discharged

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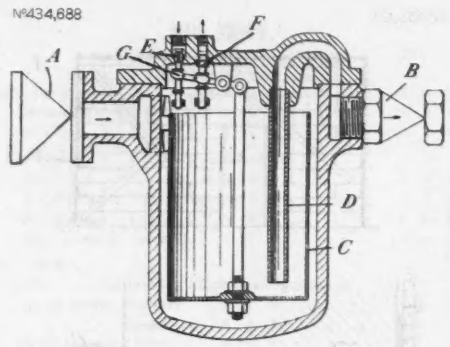

up the pipe D. For this purpose the bell controls two valves E and F through the lever G. The valve E is connected with a supply of steam and the valve F is open to atmosphere. When the float fills the parts take the positions illustrated, with the steam valve open and the atmospheric valve closed. The accumulated water is then blown out, the float rises, the steam valve is closed, and the cycle is repeated.—*September 6th*, 1935.

434,731. March 8th, 1934.—PACKINGS, *Crane Packing, Ltd., Slough, Bucks.*

This packing is made of a deformable backing strip which may be formed of asbestos, flax, cotton, or generally any non-metallic material, such as rubber, canvas, hemp, or pulverulent material such as cork, with or without a binder, and which possesses the property of resilience to some degree, and a sealing or facing strip A of metal, such as lead, copper, an appropriate

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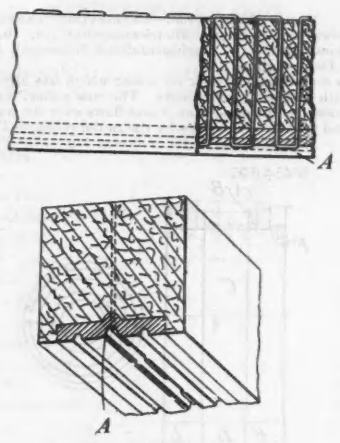

alloy, or generally any anti-friction non-scoring metal which is softer than that which composes the part with which the packing may be used. It is contemplated that an asbestos backing strip may be employed for sealing steam, air, hot gases, and hot oils, while a flax or cotton backing strip may be employed in connection with the sealing of cold oils, or other materials having a similar temperature. The metal strip is grooved as shown and is stitched on to the backing.—*September 9th*, 1935.

434,741. March 13th, 1934.—REVERSING GEARS, E. J. Lane, Kilnwood, Richmond-road, Kingston, Surrey.

This reversing mechanism is put forward primarily for laundry washing machines, but might be used for other purposes where a belt drive is used, and it is imperative that the periods of operation in each direction are equal. The drive originates from the open and crossed belts A and B, and works the drum C. The belts are moved from the loose pulleys D and E on to the fixed driving pulley F by the striking gear G. This is of a

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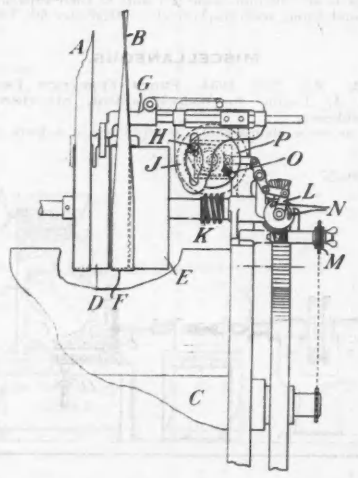

familiar type operated by the movement of a crank pin H in a slotted plate J and actuated by the worm K. Correction for belt slip is effected by the pointer L, which is driven through the sprocket chain M. The two pegs N in the driving plate do not move the pointer L unless the drum C overruns in either direction. If the pointer is moved the linkwork O moves a slide P, and, by means of an excentric action, alters the length of "dwell" of the crank pin H in the slotted plate J at opposite ends of the stroke.—*September 9th*, 1935.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Monday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

INST. OF ELECTRICAL ENGINEERS: N.-EASTERN STUDENTS.—Armstrong College, Newcastle-upon-Tyne. "The Cathode Ray: An Aid to Measurement," Mr. B. C. Robinson. 7.15 p.m.

INST. OF MECHANICAL ENGINEERS.—Storey's-gate, St. James's Park, S.W.1. Extra general meeting. "Strength of Metals, Under Combined Alternating Stresses," Dr. H. J. Gough and Prof. H. V. Pollard. 6 p.m.

INST. OF STRUCTURAL ENGINEERS: WESTERN COUNTIES BRANCH.—Municipal Technical College, Bath. Meeting.

JUNIOR INST. OF ENGINEERS.—39, Victoria-street, S.W.1. Informal meeting. Lecture, "Metal Spraying," Major H. J. Williams. 7.30 p.m.

NORTH-EAST COAST INST. OF ENGINEERS AND SHIPBUILDERS.—At Mining Inst. Newcastle-upon-Tyne. Fourth Andrew Laing Lecture, "Heavy Oil Engines for Ship Propulsion," Eng.-Comm. C. J. Hawkes, R.N. (ret.). 7 p.m.

PHYSICAL SOC.—At Imperial College of Science and Technology, S.W.7. Editing Committee meeting, 3.30 p.m.; Council meeting, 4 p.m.; meeting, 4.45 for 5 p.m.

ROYAL INST. OF GREAT BRITAIN.—21, Albemarle-street, Piccadilly, W.1. Discourse, "The Liberation of the Electron," Mr. C. C. Paterson. 9 p.m.

SATURDAY, NOV. 2ND.

INSTITUTE OF BRITISH FOUNDRYMEN: LANCASHIRE BRANCH.—Engineers' Club, Manchester. "Diecasting," Mr. D. H. Munday. 4 p.m.

NORTH OF ENGLAND INST. OF MINING AND MECHANICAL ENGINEERS.—Newcastle-upon-Tyne. Presidential Address, Sir Frank R. Simpson. 2.30 p.m.

MONDAY, NOV. 4TH.

BRADFORD ENGINEERING SOC.—Technical College, Bradford. "Determination of Fan Performance in the Boiler-house," Mr. D. S. Macfarlane. 7.30 p.m.

ENGINEERS' GERMAN CIRCLE.—At Inst. of Mechanical Engineers, Storey's-gate, S.W.1. "Die Entwicklung der Neuzeitlichen Fahrzeug-Dieselmaschine in Deutschland," Dr.-Ing. L. Hausfelder. 5.30 for 6 p.m.

INST. OF STRUCTURAL ENGINEERS: JUNIOR MEMBERS.—10, Upper Belgrave-street, S.W.1. "Steelwork Erection," Mr. H. W. Brinkworth. 7 p.m.

INST. OF STRUCTURAL ENGINEERS: MIDLAND COUNTIES BRANCH.—James Watt Memorial Inst., Birmingham. "Structural Welding," Mr. A. Ramsay Moon. 6.30 p.m.

ROYAL AERONAUTICAL SOC.—At Inst. of Electrical Engineers, Savoy-place, W.C.2. "The Prevention of Ice Accretion," Mr. B. Lockspeiser. 5.30 for 6 p.m.

SHEFFIELD METALLURGICAL ASSOC.—Joint meeting with Iron and Steel Inst., Mappin Hall, University Applied Science Dept., Sheffield. Dr. W. H. Hatfield will open discussion on "The Sixth Report of the Heterogeneity Committee of the Iron and Steel Institute" Two Sessions. 3 p.m. and 7.30 p.m.

SOC. OF CHEMICAL INDUSTRY: FOOD GROUP.—Burlington House, Piccadilly, W.1. Jubilee Memorial Lecture by Prof. T. M. Heilbron, F.R.S. 8 p.m.

WOLVERHAMPTON AND DISTRICT ENGINEERING SOC.—Victoria Hotel, Wolverhampton. "Mechanical Equipment of Modern Coke Ovens," Mr. H. C. Wood. 7.30 p.m.

TUESDAY, NOV. 5TH.

ELECTRODEPOSITORS' TECHNICAL SOC.: MIDLANDS CENTRE.—James Watt Memorial Inst., Birmingham, 3. Exhibition of lantern slides appertaining to electrochemistry, Mr. L. Wright. 7.30 p.m.

INST. OF AUTOMOBILE ENGINEERS.—At Royal Soc. of Arts, John-street, Adelphi, W.C.2. "Cylinder Materials and Finish from the Users' Point of View as Distinct from that of the Castings Manufacturer," Mr. K. Brozyna. 7.45 p.m.

INST. OF CIVIL ENGINEERS.—Great George-street, S.W.1. Presidential Address, Mr. J. D. Watson. Presentation of medals awarded by Council. 6 p.m.

INST. OF ELECTRICAL ENGINEERS: NORTH MIDLAND STUDENTS.—Hotel Metropole, Leeds. Chairman's address, "Payment by Results," Mr. J. W. Ginn. 7.15 p.m.

INST. OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND.—39, Elmbank-crescent, Glasgow, C.2. "Recent Developments in Steel-frame Construction," Mr. C. J. Kavanagh. 7.30 p.m.

INST. OF STRUCTURAL ENGINEERS: S. WALES AND MONMOUTH BRANCH.—South Wales Inst. of Engineers, Cardiff. Chairman's Address, Mr. D. Manolopoulos. 7 p.m.

UNIVERSITY OF LONDON: KING'S COLLEGE.—Strand, W.C.2.—"Diesel Engines and Coastal Shipping," Dr. S. J. Davies. 5.30 p.m.

WEDNESDAY, NOV. 6TH.

INST. OF CIVIL ENGINEERS: BIRMINGHAM AND DISTRICT ASSOCIATION.—Visit to the aircraft factory and aerodrome of Sir W. G. Armstrong Whitworth Aircraft, Ltd., Whitley, Coventry, and to the aircraft engine works of Armstrong Siddeley Motors, Ltd., Coventry. 2 p.m.

INST. OF ELECTRICAL ENGINEERS: WIRELESS SECTION.—Savoy-place, W.C.2. Chairman's Address, Mr. R. A. Watson Watt. 5.30 for 6 p.m.

INST. OF HEATING AND VENTILATING ENGINEERS.—At London School of Hygiene and Tropical Medicine, Keppel-street, Gower-street, W.C.1. "Electric Thermal Storage," Mr. John Eden. 7 p.m.

INST. OF METALS.—Joint meeting with the Manchester Metallurgical Soc. Engineers' Club, Manchester. Dr. H. W. Brownsdon will open discussion on "Metal Melting." 7 p.m.

ROYAL SOC. OF ARTS.—John-street, Adelphi, W.C.2. Presentation of medals. Address, "International Boundaries," Col. Sir Henry McMahon. 8.30 p.m.

THURSDAY, NOV. 7TH.

INST. OF ELECTRICAL ENGINEERS.—Savoy-place, Victoria Embankment, W.C.2. "Equipment and Performance of Steel Tank Rectifier Traction Sub-stations Operating on the Underground Railways of the London Passenger Transport Board," Mr. A. C. Lunn. 5.30 for 6 p.m.

INST. OF METALS: BIRMINGHAM LOCAL SECTION.—At James Watt Memorial Inst., Birmingham. Open discussion, "The Hot Rolling of Sheets." 7 p.m.

INST. OF METALS: LONDON LOCAL SECTION.—At Royal School of Mines, S. Kensington, S.W.7. "The Ultimate Strength of Metals," Dr. E. N. da C. Andrade. 8 p.m.

INST. OF MINING AND METALLURGY.—Cinema Hall, South Africa House, Trafalgar-square, W.C.2. By invitation of the High Commissioner for Union of South Africa. Film, "The Golden Harvest of the Witwatersrand." 5.15 p.m.

INST. OF STRUCTURAL ENGINEERS.—10, Upper Belgrave-street, S.W.1. Lecture, "The Authority and Liability of the Engineer under Contract with his Employer, whether such Engineer is Employed by the Owner or Contractor or the Agent on Behalf of the Owner or Contractor; with Special Reference to the Arbitration Acts, 1889–1934," Mr. Ernest Wetton. 6.30 p.m.

THURSDAY TO SATURDAY, NOV. 7TH TO 16TH.

COMMERCIAL MOTOR TRANSPORT EXHIBITION.—Olympia, Kensington, W. Open daily.

FRIDAY, NOV. 8TH.

INST. OF METALS: SHEFFIELD LOCAL SECTION.—In Non-Ferrous Section of the Applied Science Dept. of the University, St. George's-square, Sheffield. "Rolled Gold and its Industrial Applications," Mr. E. A. Smith. 7.30 p.m.

JUNIOR INST. OF ENGINEERS.—39, Victoria-street, S.W.1. Annual general meeting. 7.30 p.m.

RAILWAY CLUB.—At Royal Scottish Corporation Hall, Fetter-lane, E.C.4. "Continental Railways," Mr. W. A. Willox. 7.30 p.m.

SATURDAY, NOV. 9TH.

INST. OF ELECTRICAL ENGINEERS: N. MIDLAND STUDENTS.—Visit to *Yorkshire Evening News*, Leeds. 3 p.m.

INST. OF MARINE ENGINEERS: JUNIOR SECTION.—85–88, The Minories, E.C.3. Dance. 7.30–11.15 p.m.

MONDAY, NOV. 11TH.

CHARTERED SURVEYORS' INST.—12, Gt. George-street, S.W.1. Presidential address, Mr. H. M. Stanley. 6.30 p.m.

INST. OF METALS: SCOTTISH LOCAL SECTION.—In Rooms of Inst. of Engineers and Shipbuilders in Scotland, 39, Elmbank-crescent, Glasgow. Chairman's address, Mr. J. W. Donaldson. 7.30 p.m.

TUESDAY, NOV. 12TH.

INST. OF AUTOMOBILE ENGINEERS.—At the Geisha Café, Coventry. "Undue Cylinder Wear in Internal Combustion and Steam Engines," Mr. H. J. Young. 7.30 p.m.

INST. OF BRITISH FOUNDRYMEN: BURNLEY SECTION.—Municipal College, Ormerod-road, Burnley. "Castings Viewed from the Machine Shop *re* Machinability," Mr. John Jackson. 7.15 p.m.

INST. OF MARINE ENGINEERS.—85–88, The Minories, E.C.3. "Developments in the Measurement of Torque and Thrust in Ships," Mr. V. W. H. Towns. 6 p.m.

INST. OF METALS: N. EAST COAST LOCAL SECTION.—Join meeting with Newcastle branches of Soc. of Chemical Industry and Inst. of Chemistry. At Armstrong College, Newcastle-upon-Tyne. "The Manufacture of Zinc," Mr. Stanley Robson. 7.30 p.m.

INST. OF METALS: SWANSEA LOCAL SECTION.—Y.M.C.A., Swansea. Chairman's address, Mr. Roosevelt Griffiths. 6.30 p.m.

SHEFFIELD METALLURGICAL ASSOC.—198, West-street, Sheffield, 1. "Laboratory Work Fifty Years Ago," Mr. H. Brearley. 7.30 p.m.

UNIVERSITY OF LONDON: KING'S COLLEGE.—Strand, W.C.2.—"The History of Mechanical Invention," Mr. H. W. Dickinson. 5.30 p.m.

WEDNESDAY, NOV. 13TH.

BELFAST ASSOC. OF ENGINEERS.—Queen's Hotel, Victoria-street, Belfast. Presidential address, "Thermal Electric Stations," Mr. H. R. Ayton. 7.45 p.m.

BRITISH SCIENCE GUILD.—Norman Lockyer Lecture. At Goldsmiths' Hall, E.C. "The Calculus of Plenty," Sir Josiah Stamp. 4.30 p.m.

INST. OF STRUCTURAL ENGINEERS: LANCASHIRE AND CHESHIRE BRANCH.—College of Technology, Manchester. "The Earthquake Resistance of Structures," Mr. C. W. Hamann. 7 p.m.

LIVERPOOL ENGINEERING SOC.—9, The Temple, 24, Dale-street, Liverpool. "The Effect of High Temperature on the Properties of Steel," Mr. W. Barr. 6.30 p.m.

THURSDAY, NOV. 14TH.

INST. OF AUTOMOBILE ENGINEERS.—At Merchant Venturers' Technical College, Bristol. "Small Car Engines," Mr. L. J. Shorter. 7 p.m.

INST. OF STRUCTURAL ENGINEERS.—10, Upper Belgrave-street, S.W.1. "Some Bridge and Foundation Problems," Mr. Leslie Turner. 6.30 p.m.

FRIDAY, NOV. 15TH.

CHEMICAL ENGINEERING GROUP.—In Rooms of Chemical Soc., Burlington House, Piccadilly, W.1. "The Handling and Storing of Acids," Mr. T. J. Dixon and Dr. F. Roffey. 8 p.m.

INST. OF ELECTRICAL ENGINEERS: METER AND INSTRUMENT SECTION.—Pagani's Restaurant, 42, Gt. Portland-street, W.1. Annual dinner, 6.45 for 7 p.m.; concert and reunion, 9.30 p.m.

JUNIOR INST. OF ENGINEERS.—39, Victoria-street, S.W.1. "Notes on Small Injectors and Ejectors," Mr. L. M. G. Ferreira. 7.30 p.m.

NORTH-EAST COAST INST. OF ENGINEERS AND SHIPBUILDERS.—At Mining Inst., Newcastle-upon-Tyne. "Shipbuilding by Welding," Mr. Norman M. Hunter. 6 p.m.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

RONALD TRIST AND CO., Ltd., have removed their office from 56, Victoria-street, S.W.1, to 1–3, Brixton-road, S.W.9. At the same time they have transferred their works from Watford to a site in close proximity to the new offices.

BALDWINS LTD. inform us that as from November 16th the address of their registered and head office will be P.O. Box 255, Shell-Mex House, Victoria Embankment, W.C.2, and that the address of their London sales office will be P.O. Box 286, Shell-Mex House, Strand, W.C.2.

MR. A. T. COTTON has retired from his official position as superintending marine engineer for the London, Midland and Scottish Railway, but is continuing to act in a consultative capacity. The Turbine Furnace Company, Ltd., of London, is retaining his services in connection with marine work.

"TRENDS."—This is the title of a new monthly graphics review of business movements, published by Harold Whitehead and Staff, 20, Buckingham-gate, S.W.1. It is intended to provide the business executive with a reliable and easily read guide to prevailing business conditions and prospects. It relies upon statistics issued by various authoritative sources, assembling and correlating them, and finally presenting them in the form of charts. It is hoped that it will prove of particular use in forecasting the immediate future of business and industries